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Golden Gate Long Range Transportation Program

San Francisco Transit Route Studies

Final Report

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Golden Gate Long Range Transportation Program

Phase II–Element A

San Francisco Transit Route Studies

submitted to

Golden Gate Corridor Board of Control

REPORT 75 - 7 - RE
APRIL 1975

prepared by
KAISER ENGINEERS
in association with
WALLACE McHARG ROBERTS and TODD
JHK and ASSOCIATES

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BOARD OF CONTROL

The San Francisco Transit Route Alternatives study not only involves issues related to the Golden Gate Corridor but also concerns local issues within the City of San Francisco and regional transportation issues within the Bay Area. Therefore, the Golden Gate Bridge Highway and Transportation District (GGBHTD), the City and County of San Francisco, and the Metropolitan Transportation Commission, through a joint exercise of powers agreement, established the Golden Gate Board of Control to supervise the study. The Board is comprised of the following nine members:

Representing the Golden Gate Bridge, Highway and Transportation District

Ronald Pelosi (Chairman)	San Francisco
Lawrence Mazzola	San Francisco
Peter Tamaras	San Francisco
Dean N. Meyer*	Marin

Representing the Metropolitan Transportation Commission

William R. Lucius (Vice Chairman)	Sonoma
John W. Dearman	San Francisco
A. W. Gatov	Marin County

Representing the City and County of San Francisco

Robert E. Gonzales	San Francisco
John L. Molinari	San Francisco

*Gary Giacomini succeeded Dean N. Meyer of Marin County in February 1975.

In October 1974, the Board of Control resolved to expand its membership by adding ex-officio members representing Marin County, Sonoma County, and the California Department of Transportation (CALTRANS). These ex-officio members are:

Ex-Officio Member Representing
Marin County (MCTD)

Robert E. Burton	Mill Valley (Mayor)

Ex-Officio Member Representing
Sonoma County

Appointment Pending

Ex-Officio Member Representing
CALTRANS

Thomas Lammers	Director, District IV

PROJECT STAFF

Dale W. Luehring	Project Director General Manager, GGBHTD
Jerome M. Kuykendall	Assistant Project Director Assistant to the General Manager for Planning and Research, GGBHTD

CITIZENS ADVISORY PANEL

The Citizens Advisory Panel (CAP) was established at the beginning of the study as a means for citizens to provide their concerns and aspirations concerning the study. The CAP is open to any interested citizen. The CAP participated in the study as a full panel chaired by Peter McCrea, with John W. Stark as Vice Chairman.

The CAP also developed study groups to review and make recommendations on the technical work of the study. These study groups listed below, were organized to address particular study tasks or special areas of interest.

Draft Policies

System Criteria

Urban Planning Criteria

Environmental Criteria

Route Concepts

Low Cost (Surface) Alternatives

Patronage Forecasting

Environmental Assessment

Urban Planning and Design

Economics and Financing

Engineering and Cost Estimating

Alternatives Analysis

Implementation Policies

William H. Liskamm, AIA, AIP was selected by the Board of Control to act as the Citizen Liaison Coordinator.

TECHNICAL ADVISORY GROUP

The Technical Advisory Group (TAG) is composed of professional staff representatives from all local, regional, and State public agencies that have a concern with the study. The group reviewed and commented on the technical work of the study in order to coordinate the study with the plans of their represented agencies. The following agencies participated in the group:

GOLDEN GATE CORRIDOR PROJECT SPONSORS

Golden Gate Bridge, Highway and Transportation District

- General Manager
- Project Director, TAG Chairman

Metropolitan Transportation Commission

- Executive Director

City and County of San Francisco

- Director of Transportation, Public Utilities Commission
- Director, City Planning Department
- Director, Public Works Department
- General Manager, Municipal Railway
- General Manager, Recreation & Parks Department

U.S. GOVERNMENT

- Department of Transportation Urban Mass Transportation Administration UMTA Representative, Region IX
- Chief, Master Planning, U.S.A.R. Facilities Office - Presidio

STATE OF CALIFORNIA

- District Director, CALTRANS District IV (San Francisco)
- Chief Engineer, Division of Bay Toll Crossings
- Superintendent, CALTRANS District II (Santa Rosa)

MARIN COUNTY

- Director, Planning Department
- Director, Public Works Department
- General Manager, Transit District
- Director, Parks & Recreation Department

SONOMA COUNTY

- Director, Planning Department
- Director, Public Works Department
- Director, Parks & Recreation Department

NAPA COUNTY

Director, Planning Department

Director, Public Works Department

CITIES

Director, Public Works Department, Ukiah, California

Director, Crescent City, California

Director of Planning, City of Sausalito, California

REGIONAL AGENCIES

Executive Director, Association of Bay Area Governments

Executive Director, Bay Conservation and Development Commission

Assistant General Manager, Bay Area Rapid Transit District

Transit Task Force, San Francisco, California

Project Director, Golden Gate Recreational Travel Study

SECTION I

I. INTRODUCTION

The Golden Gate Bridge and Highway District was created by the State Legislature in 1928 to build and operate a bridge across the Golden Gate Strait. The District represents the counties of San Francisco, Marin, Sonoma, portions of Napa and Mendocino, and Del Norte. From the opening of the Golden Gate Bridge in 1937 until 1969, the Golden Gate Bridge and Highway District's sole concern was managing the increasing highway traffic on the Bridge and retiring the revenue bonds.

In 1969, when auto traffic began exceeding the design capacity of the Bridge and causing heavy congestion, the State Legislature authorized the District to study and improve all transit modes within its boundaries. The name of the District was changed to the Golden Gate Bridge, Highway and Transportation District (GGBHTD). The GGBHTD was required to report its long-range transportation facilities plan to the State Legislature by April 1971.

During 1970, the GGBHTD conducted a technical study and held public hearings which examined the long-range transportation alternatives within the Corridor. The study investigated a wide range of bus and rail alternatives that were designed to meet the Corridor's transportation needs to the year 2015. The GGBHTD shared the public's concern that long-range plans be flexible. In its report, delivered to the State Legislature in April 1971, the GGBHTD recommended a phased plan using a bus and ferry system as the intermediate transit solution. The advantage of this phased plan is that it enables GGBHTD to increase transit capacity only as needed, to incorporate technological advances and to program capital outlays, while closely monitoring environmental factors.

The State authorized the GGBHTD to proceed with the bus and ferry system and instructed it to report back to the Legislature in June 1973 (later changed to April 1975) with further details of its long-range plan.

The bus system is planned to grow through a series of phased improvements into an exclusive bus rapid transit system operating on its own rights-of-way. The route alignments and structures are to be designed so that a fixed guideway system could evolve if such a transition proves desirable. In 1971, the GGBHTD implemented a bus system which replaced the existing Greyhound service. The new bus service was based on studies made by the Marin County Transit District. The bus service

has expanded to serve over 8,500 commuters each day, which is more than twice the initial bus patronage. The expansion of the bus system has reduced commute hour auto traffic to 1969 levels. A new ferry terminal at Larkspur is planned to open in early 1976. High speed ferries, which are currently under construction, will depart every 30 minutes for San Francisco. Feeder bus service will be coordinated with the departures.

The GGBHTD's goal for 1980 is to have over 50% of the peak period commuters using public transportation. In addition to the bus and ferry system, the GGBHTD has initiated one-way tolls and reversible lanes to help alleviate traffic congestion. The GGBHTD, in cooperation with the State Department of Transportation, has implemented reserve bus lanes on Highway 101 from the Bridge to Greenbrae.

In its report to the State, the GGBHTD identified the area with the highest priority for transit improvement as that portion of the City of San Francisco between the Golden Gate Bridge and the Financial District. To further advance their phased plan for this section of the transit system, the study described in this report was undertaken. A Board of Control was established, made up of members from the San Francisco Board of Supervisors and the Metropolitan Transportation Commission, in addition to the members from the GGBHTD. This study is funded through these agencies with a grant from the Federal Urban Mass Transportation Administration (UMTA). The Board selected Kaiser Engineers, assisted by Wallace, McHarg, Roberts and Todd, Urban Planning and Architectural Consultants, and JHK and Associates Patronage Forecasting and Traffic Engineering Consultants, to conduct the technical work.

A policy of the San Francisco Board of Supervisors dictated that only improvements that completely separate the buses from existing street traffic be investigated during the study. Essentially, this limited the study to underground routes. Subsequent to strong recommendations by the Citizens Advisory Panel (CAP), the Board of Control expanded the scope of the study to investigate low cost route alternatives, such as reserved bus lanes on city streets. The San Francisco Board of Supervisors also rescinded their earlier policy. In addition, the analysis of subaqueous tube route alternatives from Marin County to San Francisco was included in the study.

This report will be used by the GGBHTD as the basis to plan route improvements in San Francisco through 1990. The information in the report will also be incorporated with other elements of the GGBHTD's long-range Corridor plans to be reported to the State Legislature in April 1975.

SECTION II

II. SUMMARY

The Golden Gate Bridge, Highway and Transportation District (GGBHTD), in its 1971 Transportation Facilities Plan, identified that portion of its transit system within the City of San Francisco as the area with the highest priority for major improvements. The purpose of this current study was to develop and analyze route alternatives that would improve the Golden Gate transit service within San Francisco. The GGBHTD will develop a phased transportation plan partially based on this study. The objective of the GGBHTD is to develop a plan that offers the best opportunity for improving transit service with the least negative impact on local neighborhoods.

Policy assumptions were developed in cooperation with the Citizens Advisory Pannel (CAP) and the Technical Advisory Group (TAG), then approved as a policy statement by the Board of Control. Criteria for identifying, analyzing, and selecting route alternatives were developed and approved in the same manner.

Initially, over 60 alternatives were examined as potential routes for the Golden Gate buses within San Francisco. The most attractive alternatives were selected for more detail study. The selected routes fall into the following five general route concepts.

- Dispersed Surface Routes
- Single Surface Routes
- Subsurface Routes
- Subaqueous Tube Route
- Joint Use Facility in the Northwest Corridor

The existing bus system is used as the base to compare the alternative improvements. An increase in peak period patronage from 8,900 in 1975 to 11,700 in 1990 is forecasted for the existing bus system without route improvements in San Francisco. Assuming no change in the existing system within San Francisco, travel time from the Golden Gate Bridge Toll Plaza to the Financial District is forecast to increase over 25% by 1990.

The Summary Fact Sheet on the next page contains information comparing each of the route alternatives with the existing system.

SUMMARY FACT SHEET
(1990 Conditions)

Item	EXISTING SYSTEM	DISPERSED ROUTE	N. Pt./Bay (S1)	SINGLE SURFACE ROUTES							SUBSURFACE ROUTES		SUBAQUEOUS TUBE ROUTE
				Lombard Reserve Lane			Lombard Contraflow Lane				Kearny Route	Battery Route	
				N. Pt. (S2)	Underpass (S3)	Tunnel (S4)	N. Pt./Bay (S5)	N. Pt. (S6)	Underpass (S7)	Tunnel (S8)			
Travel Time. From Toll Plaza to Financial District Station in minutes	28.6	30.2	16.6	16.6	15.2	12.5	16.6	16.6	15.2	12.5	9.4	9.6	14(1)
Patronage. 1990 one-way, peak period													
-Bus riders	11,700	11,700	12,800	12,800	12,900	13,000	12,800	12,800	12,900	13,000	14,700	15,000	15,800
-Number of buses to financial district	200	150	220	220	230	230	220	220	230	230	290	300	-
-Total number of buses	290	290	320	320	330	330	320	320	330	330	370	380	400
-Auto reduction	0	0	850	850	920	1,000	850	920	1,000	1,000	2,300	2,540	3,150
Accessibility. Number of people within 5 minute walk of service in San Francisco													
-Employees	282,000	325,000	282,250	273,450	270,000	270,000	282,250	273,450	270,000	270,000	237,000	249,000	87,500
-Residents	75,000	97,000	77,500	69,900	62,500	62,500	77,500	69,900	62,500	62,500	65,000	59,000	200
-Transit dependents	31,000	38,000	31,200	28,450	26,100	26,100	31,200	28,450	26,100	26,100	28,000	24,000	200
Short-Term Impacts.													
-Construction disruption	None	None	Slight	Slight	Moderate	Moderate	Slight	Slight	Moderate	Moderate	Severe	Severe	Moderate-to-Severe
-Construction employment in person-years	None	None	25	27	130	400	24	25	130	400	Over 4,000	Over 4,000	Over 10,000
Long-Term Impacts.													
-Number of dwelling units along route	4,881	10,850 -	5,405	4,365	4,320	3,634	5,405	4,365	4,320	3,634	None	None	None
-Air pollutants (percent reduction)	None	None	1.5	1.5	1.6	1.8	1.5	1.5	1.6	1.8	4.3	4.8	6.1
-Fuel consumed(2)	142,500	142,500	-2,200	-2,200	-2,400	-2,600	-2,200	-2,200	-2,400	-2,600	-6.300	-7,000	-8.900
-Traffic conflicts	Severe	Severe	Severe	Severe	Moderate	Moderate	Moderate	Moderate	Slight	Slight	None	None	None
Displacement													
-Number of employees	None	None	None	None	None	5	None	None	None	5	859	567	1262(3)
-Number of businesses	None	None	None	None	None	1	None	None	None	1	42	26	77
-Number of parking spaces	None	None	223	172	174	174	151	100	102	102	115	105	None
Service Life. Approximate year congestion will degrade service below current level	1975	1975	1985-1990	1985-1990	After 1990	After 1995	1985-1990	1985-1990	After 1990	After 1995	N/A	N/A	N/A
Cost Data. (1975 dollars)													
-Capital cost	None	None	1,556,000	1,652,000	7,990,000	24,614,000	1,451,000	1,548,000	7,885,000	24,509,000	273,000,000	284,000,000	590,000,000(4)
-Operating cost	3,700,000	3,800,000	3,300,000	3,300,000	3,200,000	3,100,000	3,400,000	3,400,000	3,300,000	3,100,000	3,900,000	3,800,000	Not Developed
-Annual $ benefits derived	None	None	2,490,000	2,460,000	2,628,000	2,898,000	2,450,000	2,420,000	2,588,000	2,858,000	3,790,000	3,920,000	Not Developed
-Incremental benefit/cost ratio	None	None	14.56	13.5	5.69	2.44	15.41	14.24	5.75	2.43	0.33	0.33	Not Developed

(1) Travel time from Marin City to the Transbay Terminal assuming exclusive busway. Comparable to 39 minutes using the existing system.

(2) Gallons of fuel used per day by buses and autos.

(3) Further study required. Displacement depends upon route configuration on the Embarcadero to the Transbay Terminal. Based upon the assumption of an exclusive busway alignment the displacement would be as shown plus one hotel with 48 residents.

(4) Cost of construction from Marin City to Pier 37.

A. DISPERSED SURFACE ROUTES

This concept has multiple route alignments in mixed traffic on city streets. The dispersed surface alternative would have the least capital cost for fixed facilities. This alternative, in the aggregate, provides approximately the same level of service as the existing system. The dispersed alternative seems to have its maximum advantage when used in conjunction with other alternatives by extending their ability to continue to provide improved service.

The principal advantages and disadvantages of this alternative are:

- Reduces concentration of buses on any one street
- Works best when combined with other alternatives
- Service expected to degrade each year due to increased auto traffic
- Major traffic conflicts on Park Presidio Boulevard
- Generates new impacts on residential streets
- Offers best accessibility to Northwest San Francisco
- Twice as many residents potentially impacted over other alternatives

B. SINGLE SURFACE ROUTE

This route concept is a single alignment utilizing preferential treatment for buses on city streets. Included in this category are a Van Ness Underpass and a Lombard single lane tunnel improvement. Various options for the preferential treatment are presented for each segment of the route.

The single surface routes that require no major construction improvement are next least capital intensive alternatives to the dispersed routes. These are the alternatives shown as S1, S2, S5 and S6 on the Summary Fact Sheet. Each of these alternatives would cost approximately $1.5 million to implement and are similar in route alignment and route configuration. They all use reserved bus lanes on Van Ness Avenue, The Embarcadero, and on the Battery and Sansome Streets one-way couple. They differ only in that S1 and S5 would use the North Point and Bay Streets one-way couple and S2 and S6 would use the reversible bus lane on North Point Street; S1 and S2 would use the right lane as a reserved bus lane on Lombard Street and S5 and S6 would use a contraflow bus lane.

The differences among them are primarily in the area of traffic disruption, displacement of parking, and potential residential noise

impact. Using the contraflow bus lanes would ease traffic and would not take any parking spaces during the peak period. However, only the Financial District buses would use the contraflow lane leaving the Civic Center buses to provide local service, operating in mixed traffic.

The use of reserved lanes on Lombard Street (S1 and S2) would remove a lane of traffic, thus restraining the peak period, peak direction auto traffic to two lanes creating a severe traffic disruption. Parking spaces would be taken during the peak period. Use of the right-hand traffic lane for the reserved lane would upgrade both the Financial District and Civic Center bus operations on Lombard Street. The use of the right-hand reserve lane would create a severe bus operations problem for left turns onto Van Ness Avenue. Use of the left-hand traffic lanes for the reserved lanes was also considered. This configuration would have the disadvantages of both the contraflow and right-hand reserved lanes, but offers some bus operations advantages discussed below in conjunction with the Van Ness underpass.

The choice between a reversible bus lane on North Point Street and reserve lanes on a North Point/Bay Streets one way couple would depend solely on the actions of the City of San Francisco.

Service level is basically the same for these two alignments in terms of travel times; however, the use of the center lane on North Point Street for the reversible lane prohibits serving the bus stops at Kearny, Taylor and Hyde streets.

The surface alternatives that would use the Van Ness underpass are shown as S3 and S7 on the Summary Fact Sheet and would cost approximately $8 million to implement. These two alternatives differ only in the route configuration used on Lombard Street. Use of the contraflow lanes on Lombard Street would permit a smooth flow directly into and from the underpass. Use of the reserved lanes using the right-hand traffic lane would create a severe bus operations problem. In the morning peak, the buses would have to move across two lanes of auto traffic to get into the reserved lane. This operation could function properly only through preferential signalling, but would create additional traffic disruption. Shifting the reserved lane over to the left-hand traffic lane would solve the bus operations problem but would degrade the Civic Center and local service as mentioned above. Because the Van Ness underpass would portal north of Bay Street, the

underpass improvement can be used only in conjunction with the North Point reversible lane alternative and not with the North Point and Bay Streets one-way couple.

The most capital intensive of the surface alignments, approximately $24.5 million, are shown as alternatives S4 and S8 on the Summary Fact Sheet. These two alternatives use a single lane reversible tunnel under Lombard Street from Franklin Street to the eastern side of Telegraph Hill just west of Montgomery Street. The tunnel would connect the surface bus lanes on Lombard Street with the surface bus lanes on the Battery/Sansome one-way couple. The difference between these two alternatives is the route configuration on Lombard Street--either reserved lanes in the right-hand traffic lane or contraflow lanes. Use of the reserved right-hand lanes generates the same operations problem discussed above for the Van Ness underpass. The tunnel would avoid the relatively severe neighborhood impacts and congestion impacts associated with other alternatives along North Point Street and would provide the best travel time improvements.

The key advantages and disadvantages of the single route alternatives are:

- Provides preferential bus lanes
- Improves 1990 travel times within San Francisco over existing system by 12 to 16 minutes
- Offers low cost improvement opportunities
- Allows for phased capital improvements
- Offers early action program
- Disrupts traffic and parking when right-hand reserved lanes are used
- Reduces destination served when contraflow and reversible lanes are used.

C. SUBSURFACE ROUTE

This route concept is a single alignment with an exclusive transit right-of-way, primarily under city streets, which is adaptable to a fixed guideway system. This concept has two alternative alignments and station locations in the Financial District. Each of these alternatives is forecast to improve 1990 travel time within San Francisco over the existing bus route by 19 minutes. The capital cost to implement either of these subsurface alternatives is approximately $275 million. The major differences in impacts between the surface and these two subsurface alternatives are that the subsurface alternatives have more positive long-term impacts, but severe short-term construction disruption.

The key advantages and disadvantages of the subsurface route alternatives are:

- Provides exclusive transit rights-of-way
- Improves 1990 travel time within San Francisco by 7 minutes over the best surface alternatives and 19 minutes over existing system
- Offers long-term benefits
- Convertible to fixed guideway
- Creates severe construction disruption
- Requires high capital investment
- Not flexible to changing transit needs

D. SUBAQUEOUS TUBE ROUTE

This route concept is an exclusive busway through a transbay tube from Marin County to San Francisco. The 1990 travel time is forecast to improve by 5 minutes compared to the best subsurface alternative. Compared to the subsurface alternative cost of approximately $275 million, the tube would cost just under $700 million to implement not including the costs of The Embarcadero and Transbay Terminal improvements.

The key advantages and disadvantages of the subaqueous tube alternatives are:

- Reduces construction disruption in San Francisco compared to subsurface alternatives
- Offers long-term benefits to San Francisco
- Conflicts with Bay Conservation and Development Commission policy and Marin Countywide plan
- Requires very high capital investment

E. JOINT USE FACILITY IN THE NORTHWEST CORRIDOR

This concept shares a rapid transit facility with MUNI in the Geary Corridor. This concept includes both joint right-of-way and transfer possibilities. These concepts were studied in the course of this project in conjunction with the NWX Project and subsequently dropped by Board of Control action due to the decision not to build a high capacity MUNI rapid transit system in the Geary Corridor.

F. COURSE OF ACTION

The decision diagram shown in Figure II-1 presents an implementation sequence that uses the least cost alternatives first and moving to more capital intensive alternatives in the future in order to maintain the specified service level while maintaining the maximum flexibility for meeting future transit needs. The diagram shows the major implementation points. Each of these implementation points must have been preceded by the selection of an alternative.

The diagram flow begins with the existing bus system, showing it to be at the specified service level in 1975. As discussed above, any increase in congestion on city streets will degrade the existing service. The first implementation point is shown in 1975 and requires the choice between the dispersed surface alternative and those single surface alternatives that require no major construction (S1, S2, S5 and S6). The dispersed alternative is shown with a short duration of system effectiveness. As discussed above, this alternative is subject to the same service degradation because of congestion as is the existing system. By dispersing the buses onto a number of routes, the congestion impact would be lessened slightly and this alternative could

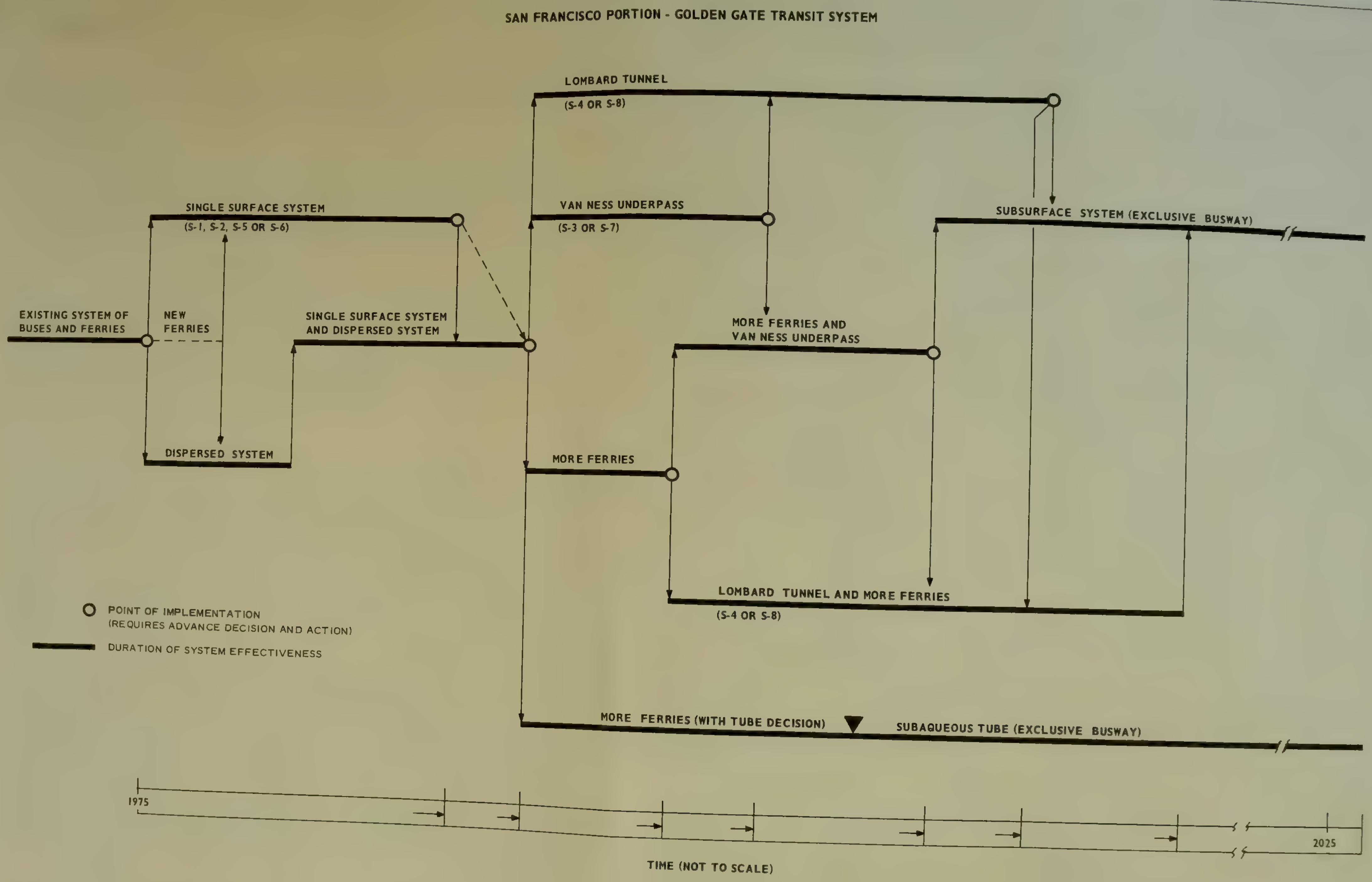

SAN FRANCISCO PORTION - GOLDEN GATE TRANSIT SYSTEM
LOMBARD TUNNEL
(S-4 OR S-8)
SINGLE SURFACE SYSTEM
(S-1, S-2, S-5 OR S-6)
VAN NESS UNDERPASS
(S-3 OR S-7)
SUBSURFACE SYSTEM (EXCLUSIVE BUSWAY)
EXISTING SYSTEM OF BUSES AND FERRIES
NEW FERRIES
SINGLE SURFACE SYSTEM AND DISPERSED SYSTEM
MORE FERRIES AND VAN NESS UNDERPASS
DISPERSED SYSTEM
MORE FERRIES
LOMBARD TUNNEL AND MORE FERRIES
(S-4 OR S-8)
○ POINT OF IMPLEMENTATION (REQUIRES ADVANCE DECISION AND ACTION)
DURATION OF SYSTEM EFFECTIVENESS
MORE FERRIES (WITH TUBE DECISION)
SUBAQUEOUS TUBE (EXCLUSIVE BUSWAY)
1975
2025
TIME (NOT TO SCALE)

FIGURE II - 1

DECISION DIAGRAM

KAISER ENGINEERS

function at or near the specified service level for a short period. Combining the dispersed alternative with single surface alternative would have the effect of extending the duration of the alternative for a short period.

The next implementation point occurs when the selected alternative, or combination of alternatives, degrades in service to today's level. The selected single surface alternative (S1, S2, S5 or S6) in combination with the dispersed surface alternative, has a duration of approximately 10 to 15 years. Forecasts for 1985 indicate that the required bus flow rate during the peak hour would be seriously impeded at two critical intersections: Lombard Street and Van Ness Avenue, and Bay Street and Van Ness Avenue. Adjusting the traffic signal timing to provide preferential treatment for buses would cause severe impact on auto traffic. Efficient flow at these two intersections is critical to traffic operations during the peak period. These two intersections are near their capacity today, and even with surface improvements for the buses, the selected alternative would experience a degradation of service.

The next implementation point requires a more difficult decision. In order to get the maximum benefit from the implemented surface system and still postpone the most capital intensive decisions, the choice is among construction of the Van Ness underpass or the Lombard tunnel, the purchase of additional ferries, and the purchase of additional ferries coupled with a decision to proceed with the subaqueous tube. This last choice is a two-step choice because of the long lead time required for implementation of the tube and because it is considered to be mutually exclusive from the other construction choices. Commitment of capital funds for the Van Ness underpass or the Lombard tunnel, as presented in this strategy, precludes a later choice of the tube.

The alternative chosen would begin operating in a 1985 to 1990 time frame. Forecasting conditions beyond 1990 requires many assumptions to be dependable. However, the Van Ness underpass improvement would have a limited service life since buses must still operate on North Point and The Embarcadero, whereas The Lombard Tunnel improvement should last indefinitely, well into the 21st century. Either of these two construction options could have the duration of their effectiveness extended by adding more ferries at a later date. Similarly, choosing to start this period with more ferries allows the selection of the Van Ness underpass or the Lombard tunnel at a later date.

Finally, if the subaqueous tube alternative has not been selected, one of the subsurface alternatives may be required in the future, assuming that the transportation demand in the Golden Gate corridor exceeded the capacity of the post-1990 highway and transit network.

The use of such an implementation strategy as part of the long-range transportation program for the Golden Gate Corridor would permit the continuation of the planning process, provide maximum flexibility for future decision-making, and provide continued transit improvements with phased capital investments.

SECTION III

III. BASIS FOR IDENTIFYING ROUTES

The basis for identifying the alternatives which justified analysis as potentially feasible Golden Gate bus routes within San Francisco were:

- Policy statements expressing political concerns, constraints, and objectives,
- Characteristics of the study area which could influence or constrain the transit route,
- Criteria applying to the transit system and the urban and environmental impacts.

A. POLICIES

Policy assumptions affecting the operating conditions of the system were reviewed by the Technical Advisory Group and the Citizens Advisory Panel. The complete policy statement as approved by the Board of Control is given in Appendix II. A summary of the more pertinent policies follows:

1. Service

The adopted policy statement required that the Golden Gate transit system provide direct service without transfer to the Civic Center and the Financial District; that intracity service except for trips to and from the Golden Gate toll plaza not be provided; and that stations along the routes be provided to serve major activity centers and MUNI line transfer points.

2. Conceptual Routes

Study policies required that all feasible routes be examined during the conceptual route identification process even though some routes might appear to have serious objections.

3. Route Configuration

The policy also states that any facility requiring major capital investment must be planned and designed to permit future convertibility from a busway to a fixed guideway system. The basis for this requirement is found in the GGBHTD report to the California State Legislature dated April 3, 1971.

4. Joint Use with San Francisco Municipal Railway

As a matter of policy, the route analysis was required to determine the extent to which joint use of the facilities by MUNI buses would be possible. Alternative transit route improvements were also planned to accommodate MUNI buses.

5. Coordination with the Northwest Corridor Transit Extension Study

The statement required also that the Northwest San Francisco Rapid Transit Extension Study (NWX), carried out concurrently by others, be coordinated with the Golden Gate work to determine the extent to which joint use of facilities would be possible.

6. Patronage Forecast Assumptions

The policy statement required that the patronage projections be based on the existing Golden Gate bus fares.

The policy also required that the ferry patronage forecast be taken into account in the bus patronage forecast.

Patronage forecasts are to be based on bus travel times with free flow conditions on Doyle Drive, on the Bridge and in Marin County. Free flow conditions assumes the travel times with transit lanes or uncongested mixed traffic conditions.

B. CHARACTERISTICS OF THE STUDY AREA

The characteristics of the urban areas within the San Francisco segment of the Golden Gate Corridor were part of the basis for identifying and analyzing feasible bus routes.

These characteristics included:

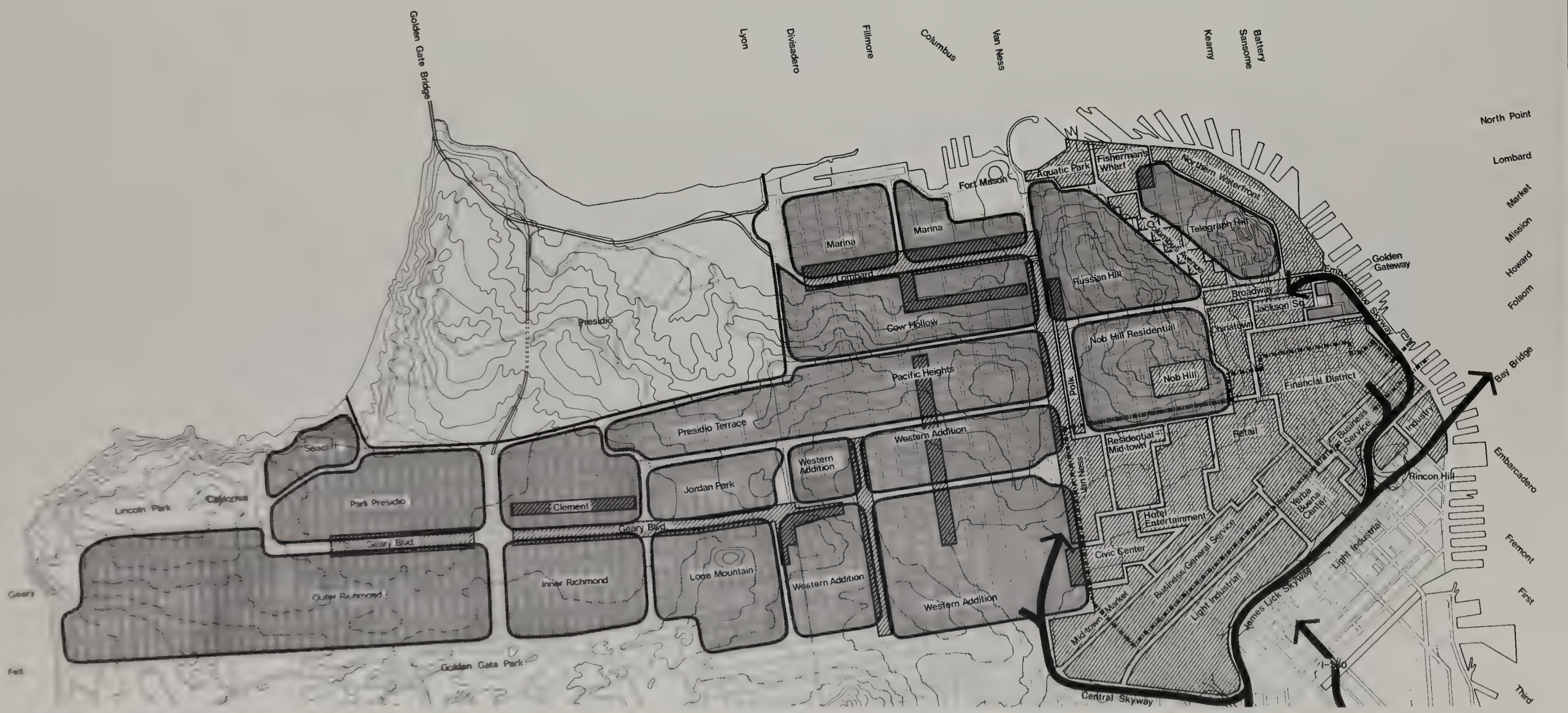
- Functional Zones
- Visual Resources
- Population Density
- Employment Density
- Transit Dependent Population
- Public Transit System
- Activity Centers
- Existing Land Use
- Development Regulations and Zoning
- Development Potential
- Geology
- Street and Highway System
- Limiting Street Gradients

This information was also used to evaluate the degree of transit service provided by each route alternative and to analyze the extent and nature of the impacts on the neighborhood resulting from the various transit systems.

1. Functional Zones

Major identifiable functional zones in the study area are shown in Figure III-1. Some of the principal nonresidential areas are the Financial District, Civic Center, Jackson Square, Fisherman's Wharf, the Embarcadero Center, and the proposed Yerba Buena Center. Residential districts include North Beach, Telegraph Hill, Russian Hill, Nob Hill, Marina, Pacific Heights, Western Addition, Chinatown and Inner and Outer Richmond.

This information is important for transit route selection because it makes possible the identification of edges between districts where short- and long-term transit impacts would be least disruptive. This concern is critical with respect to residential areas where surface transit routes and short-term construction impacts of underground routes can separate and isolate portions of neighborhoods, thereby creating adverse consequences.



Functional Zones

legend:

Residential district	■
Commercial district	▨
CBD boundary	-·-·-·-

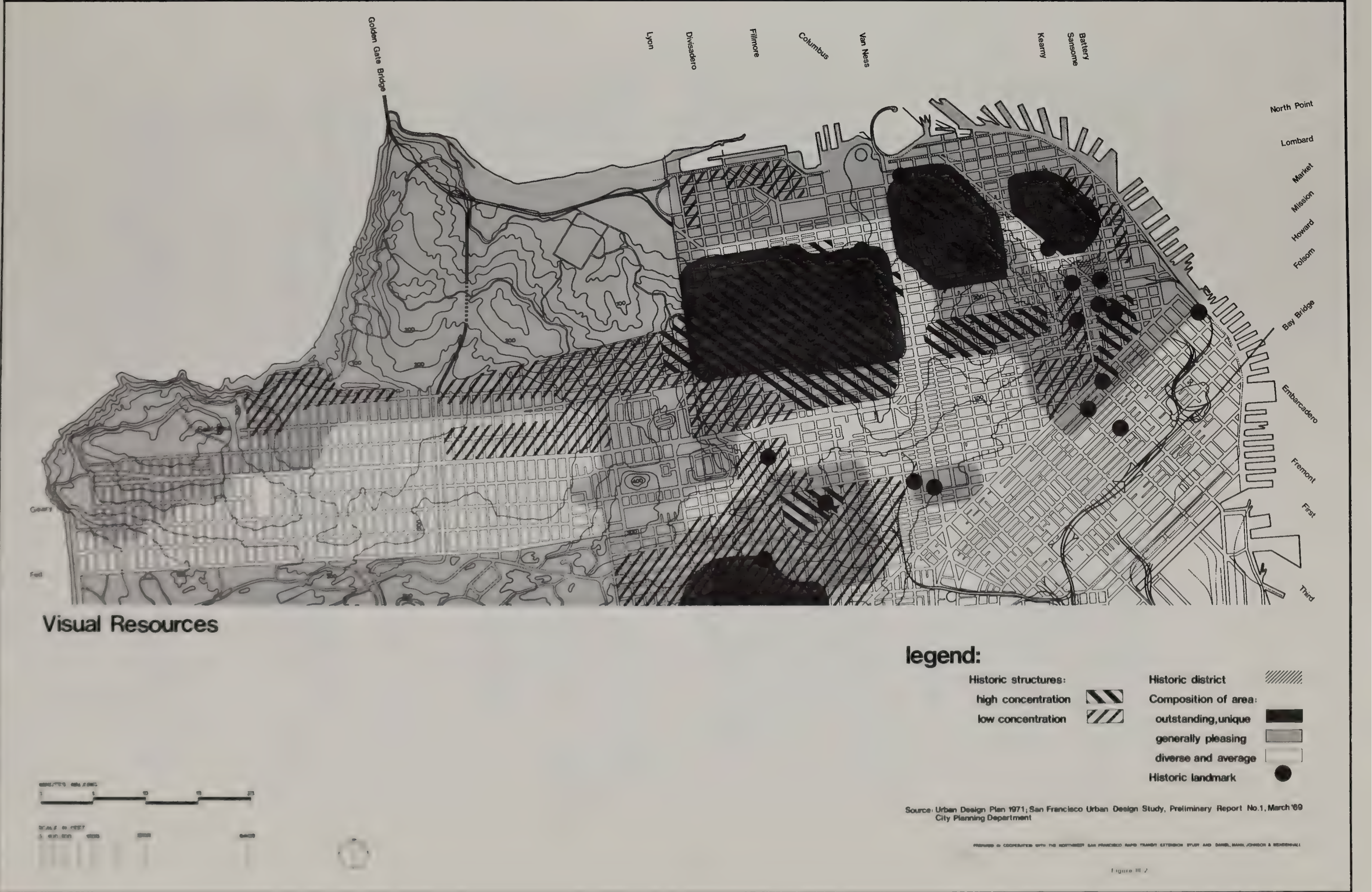
Source: City Planning Department

Figure III 1

2. Visual Resources

The San Francisco Corridor Study area is an unsurpassed combination of hills, sea, and bay. Much of the Corridor area displays more than a century of history and past development. The most visually dramatic areas of the Corridor are the natural setting found at the Golden Gate National Recreation Area and Golden Gate Park. Of the developed areas in the Corridor, the highest concentration of historic buildings and districts of architectural merit are in the northeast section of the City, including Jackson Square, Telegraph Hill, Russian Hill, and Pacific Heights areas. A number of historical buildings and landmarks as well as some of the most magnificent views of the bay, ocean, and city afforded are from these areas. The major visual resources in the Corridor are identified on the following page.

Transit routes should be planned to avoid disruptions to these visual resources and to provide transit riders pleasant views during their trip.



Visual Resources

legend:

Historic structures:
- high concentration ▧
- low concentration ▨

Historic district ▨

Composition of area:
- outstanding, unique ■
- generally pleasing ▒
- diverse and average □

Historic landmark ●

Source: Urban Design Plan 1971; San Francisco Urban Design Study, Preliminary Report No.1, March '69
City Planning Department

PREPARED IN COOPERATION WITH THE NORTHEAST SAN FRANCISCO RAPID TRANSIT EXTENSION STUDY AND DANIEL, MANN, JOHNSON & MENDENHALL

Figure III 7

3. Population Density

For planning transit routes, information on population density identifies concentrations of potential reverse commute or weekend ridership within San Francisco. A second application of this information is for planning transportation routes in which densely populated areas are least affected by construction and long-term impacts. Transit routes must be selected judiciously to maximize the level of service to the residential population and minimize adverse impacts of disruption and displacement. Corridor residential population for 1970 is displayed on the following page.

Population density in the Corridor is heaviest in the areas located north of the Central Business District between Van Ness and San Francisco Bay.[1] This area includes the Nob Hill, Russian Hill, Telegraph Hill/North Beach, and Chinatown neighborhoods. Physically, this area is typified by multiple residential dwelling units (more than ten apartments) and by buildings taller than three stories.[2] Other nodes or isolated centers of high density residential population in the Corridor are the Golden Gateway and Cathedral Hill areas.

In 1970, the San Francisco residential population in the Corridor was 258,517 persons.[3] Of this total, more than 20% lived in higher density residential areas north of the Central Business District.[4] In 1990, the Corridor population is projected to increase to approximately 263,400 persons, representing a 20-year growth rate of approximately 2%.[5] The majority of this population growth is projected to occur in the Western Addition Redevelopment area and South of Market area.

---

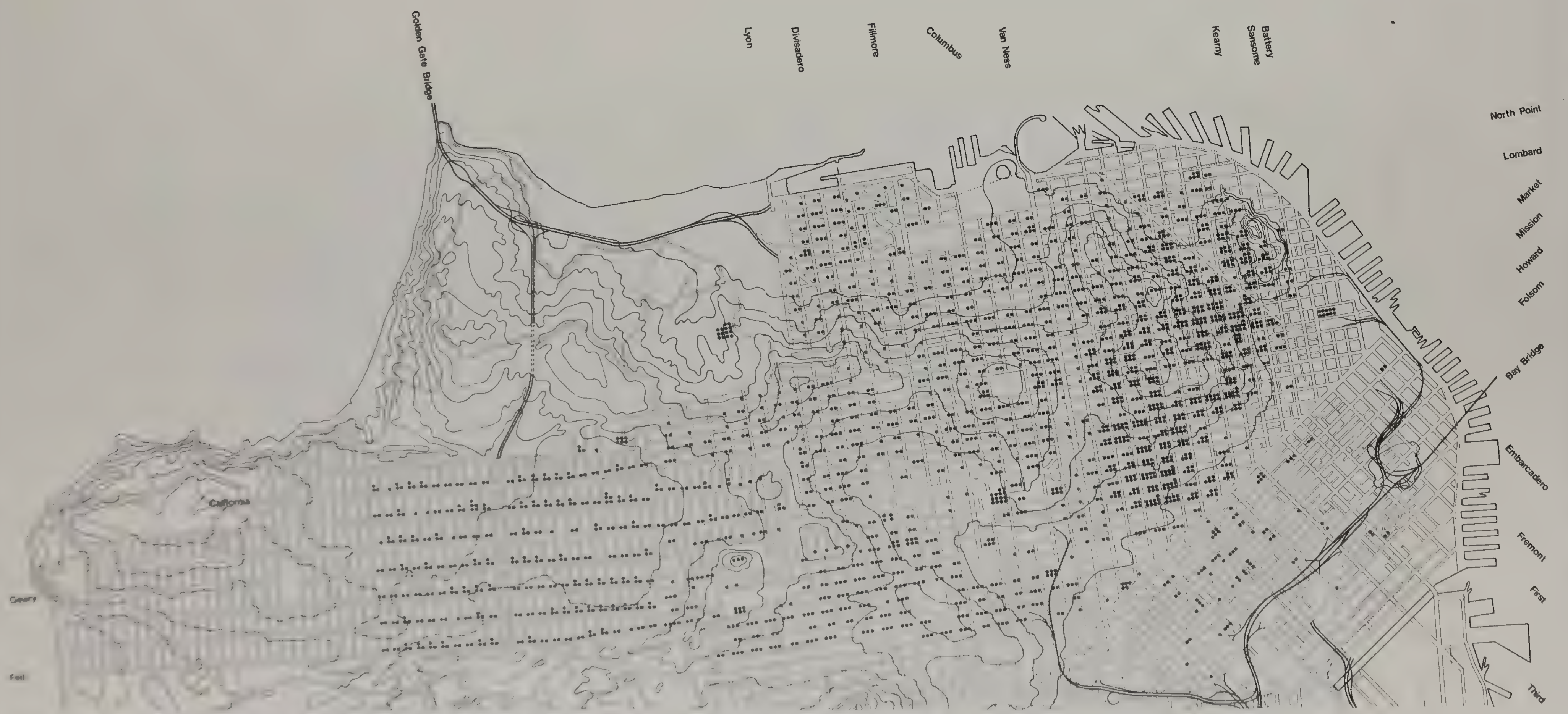
[1] "General Characteristics of Population, Table P-1," 1970 U.S. Census.

[2] Plan for Residence, San Francisco Planning Commission, 1971.

[3] "General Characteristics of Population, Table P-1," 1970 U.S. Census.

[4] Ibid.

[5] Population, Employment and Land Use Projections, S. F. Bay Region 1970-2000, Association of Bay Area Governments and Metropolitan Transportation Commission, 1973.



1970 Residential Population Density

legend:

Each dot is 100 persons •

Source: 1970 Census

Figure III-1

4. Employment Density

A key ingredient to mass transit ridership is service to centers of high employment density. Mass transit works best in a point-to-point operation between residential and employment points. The largest potential user group of an improved transit facility in the Corridor would be the Marin and Sonoma residents commuting to San Francisco for employment. In 1970, 36% (approximately 30,000 persons) of Marin County employed persons worked in San Francisco. Of these, 44% (or 13,000 persons) worked in the Central Business District. Of all the employed persons within the San Francisco Standard Metropolitan Statistical Area traveling to work in San Francisco and its Central Business District, the Marin commuters accounted for 6 and 9% respectively in 1970.[1]

Employment density in the Corridor for 1975 and for 1990 is displayed on the map which follows. At this time, 60% of the Corridor employment is located within the Central Business District (see Table III-1). About 80% of the Central Business District employment is concentrated in the Financial District; other areas which represent significant employment concentrations are the Civic Center and the Retail District. Outside of the Central Business District, the major concentrations of employment are the Embarcadero Center and Jackson Square area and, to a lesser extent, Geary Boulevard and Van Ness Avenue.

By 1990, Corridor employment is projected to increase by 16% over the base year of 1975 (see Table III-1). During the same 15-year period the employment in the Central Business District is anticipated to grow 13%; within the Central Business District, the Financial District is expected to grow about 10%, continuing to be the most dominant and dense employment center in the Corridor. Substantial employment growth is projected by 1990 in the Civic Center and South of Market area resulting from growth in government employment and completion of the Yerba Buena Center Redevelopment Project. Employment growth outside the Central Business District is predicted to grow 21% between 1975 and 1990. Much of this growth is anticipated to occur at the Embarcadero Center and the Northern Waterfront, as they shift from maritime to office use.

---

[1] "Means of Transportation and Place of Work," Table P-2, 1970 U.S. Census.

TABLE III-1

EMPLOYMENT PROJECTION

	1965[1]	1970[2]	1975[3]	1990[3]	Growth 1975-1990
San Francisco Corridor	280,749	373,615	377,300	437,000	16%
Central Business District	166,159	224,681	236,500	266,000	13%
Financial District	127,883	-	200,500	219,000	10%
Corridor less Central Business District	114,590	148,934	140,800	171,000	21%

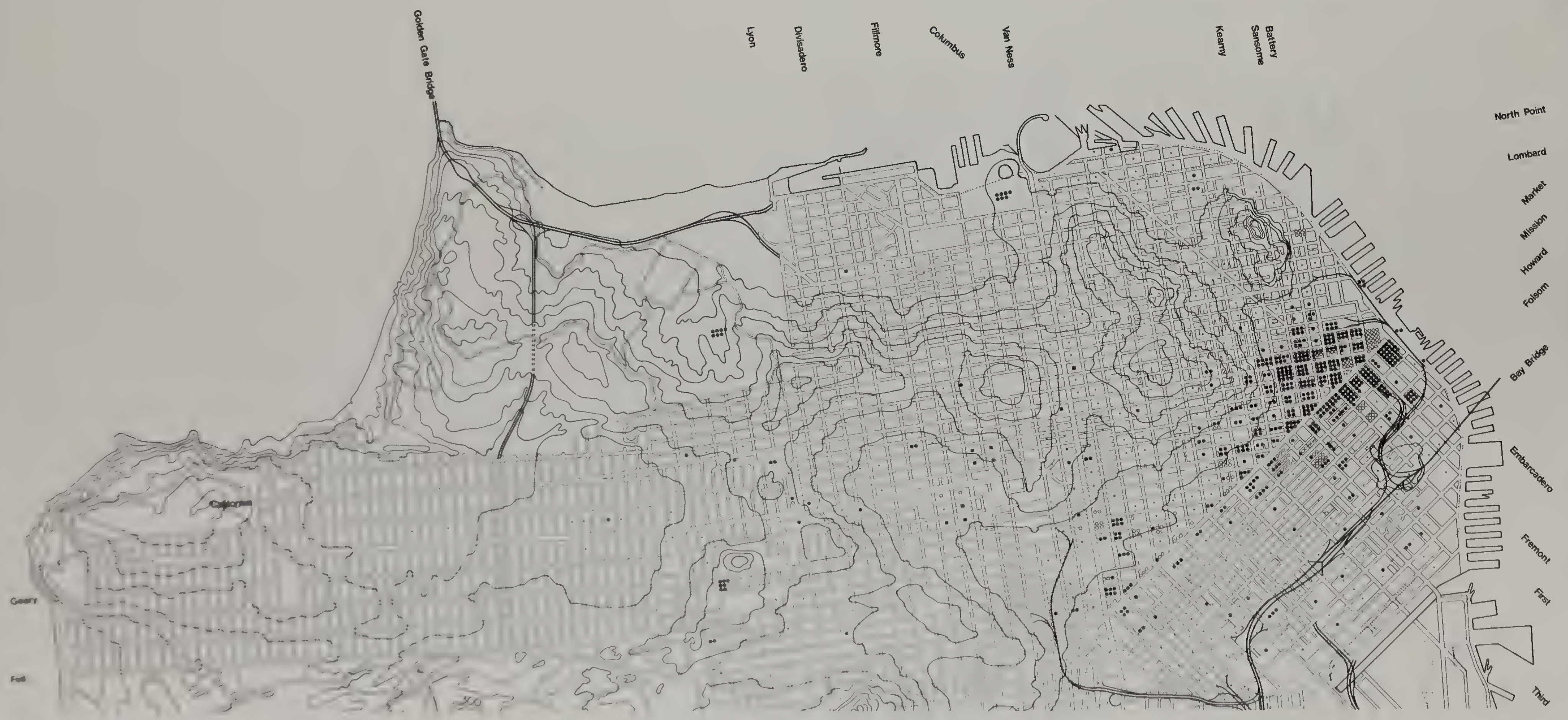
---

[1] 1965 Employment Statistics, California Department of Human Resources Development.

[2] Population, Employment and Land Use Projections, S. F. Bay Region 1970-2000, Association of Bay Area Governments and Metropolitan Transportation Commission, 1973.

[3] Association of Bay Area Governments and Metropolitan Transportation Commission employment forecasts were distributed to blocks based on data collected from the Department of City Planning concerning:

- Projects under construction to be completed by 1990 including approved redevelopment projects.
- Projects planned which had City approval e. g. EIR, building permit, etc. and secured construction financing.
- Projects proposed however no City approvals had been secured.



1975–1990 Employment Density

Source: Employment location and density from MTC data. Updated to 1975 from City Planning data.

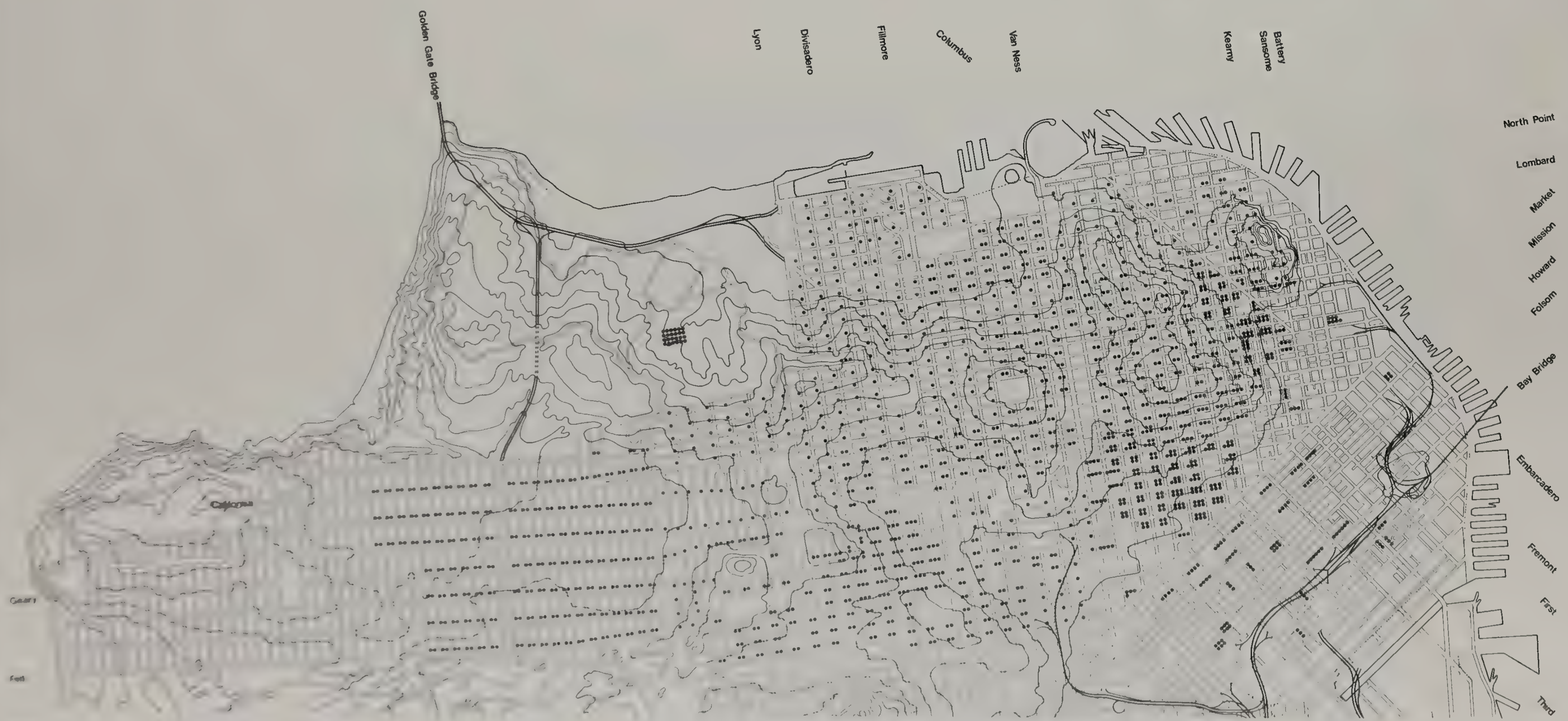
Figure III 4

5. Transit Dependent Population

The transit dependent population consists of those persons who are "captive transit riders," a group generally consisting of the young, elderly, poor, disabled, and those without cars. It is these persons that rely almost exclusively on mass transit for mobility.

The location of the transit dependent population within the Corridor is shown in Figure III-5. This information was collected to determine the transit dependents within San Francisco who may wish to travel to Marin and Sonoma Counties.

The location of the total Corridor transit dependent population was developed from 1970 Census Tract data and approximated to the block level. Transit dependents are defined as persons who are 6 to 18 years old or over 65, and persons between 18 and 65 who are below the poverty level. Areas which represented the highest density of transit dependent persons are the Chinatown/North Beach neighborhood, the midtown residential area north of the Civic Center, and the Western Addition neighborhood in the vicinity of Divisadero Street.



Transit Dependent Population

legend:

50 persons •

Source 1970 Census

Figure III-[illegible]

6. Public Transit System

An important aspect of planning transit routes in the Corridor is to maximize the transfer potential to city and regional transportation facilities. The existing major transit routes and terminals in the Corridor are shown on the following page.

Intracorridor public transportation is provided by the San Francisco Municipal Railway (MUNI). The fleet is comprised of streetcars, trolley buses, motor coaches, and cable cars. In 1970-1971[1], ten MUNI routes operating in the Corridor accounted for 54% of the City's total annual patronage. Of the ten high patronage lines, all but the Fillmore crosstown route serve the Central Business District. Other important crosstown routes with somewhat lower patronage than the ten routes mentioned above are the Divisadero, Van Ness, and 19th Avenue lines.

Intercorridor public transit service is provided by a number of carriers operating from several Central Business District terminals. BART is the major intercity transit mode with service to four Central Business District stations. The Transbay Terminal at First and Mission Streets handles the AC Transit and Greyhound bus systems. Golden Gate Transit provides ferry service to the Ferry Terminal from Marin County. The Third and Townsend Southern Pacific Station handles over 20,000 Peninsula commuters' trips daily. The Airlines Terminal at Taylor and O'Farrell Streets serves 6,000 persons daily using buses for travel to and from San Francisco International Airport.

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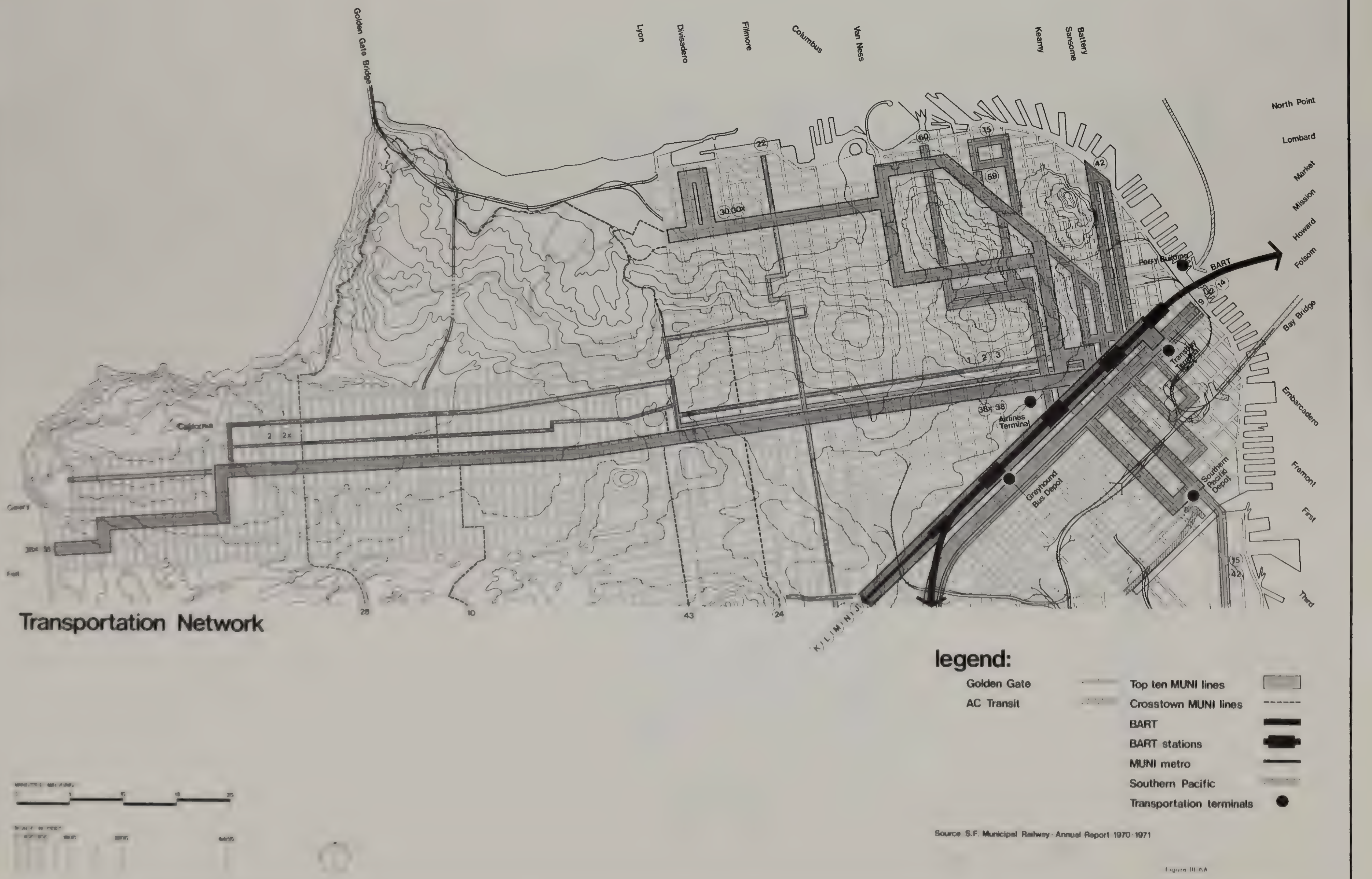
[1] Annual Report, 1970-1971, San Francisco Municipal Railway.

Transportation Network



Source S.F. Municipal Railway · Annual Report 1970 · 1971

Figure III.6A

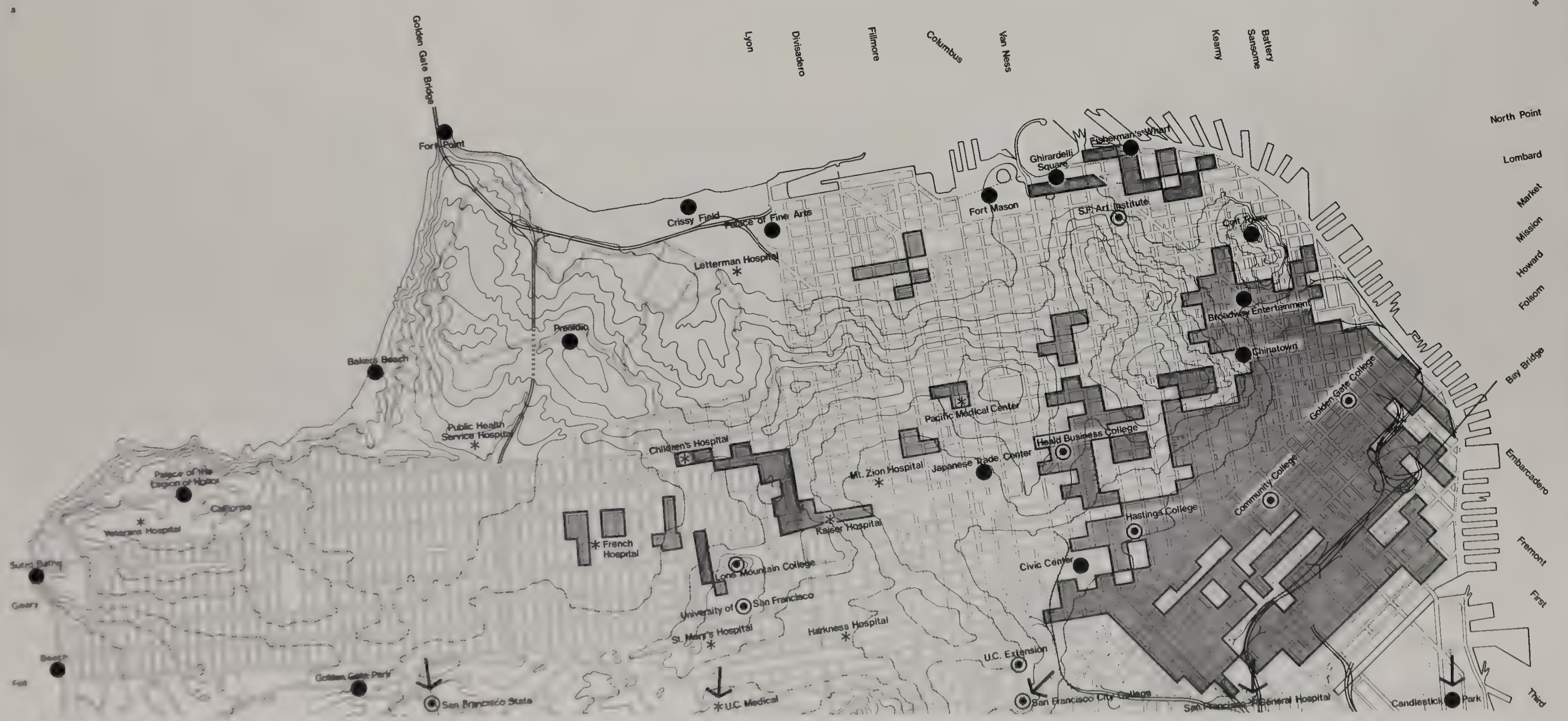
7. Activity Centers

The major regional and citywide travel destinations within the Corridor are shown in Figure III-7. These major destinations include:

- Employment Centers
- Governmental and Civic Centers
- Retail Centers
- Regional Cultural and Recreation Areas
- Universities and Colleges
- Hospitals

Good transit service to these last four activity areas would help develop fuller use of transit during nonpeak and weekend hours.

Golden Gate Park and the Fisherman's Wharf and Ghirardelli Square areas are large tourist and regional recreational areas located within the Corridor. In the future, the Golden Gate National Recreation Area is expected to generate considerable recreational use. Fort Mason is designated as the informational, transportation, and administrative center of the Recreation Area and as such will serve as a major regional recreation and travel destination.



Activity Centers

legend:

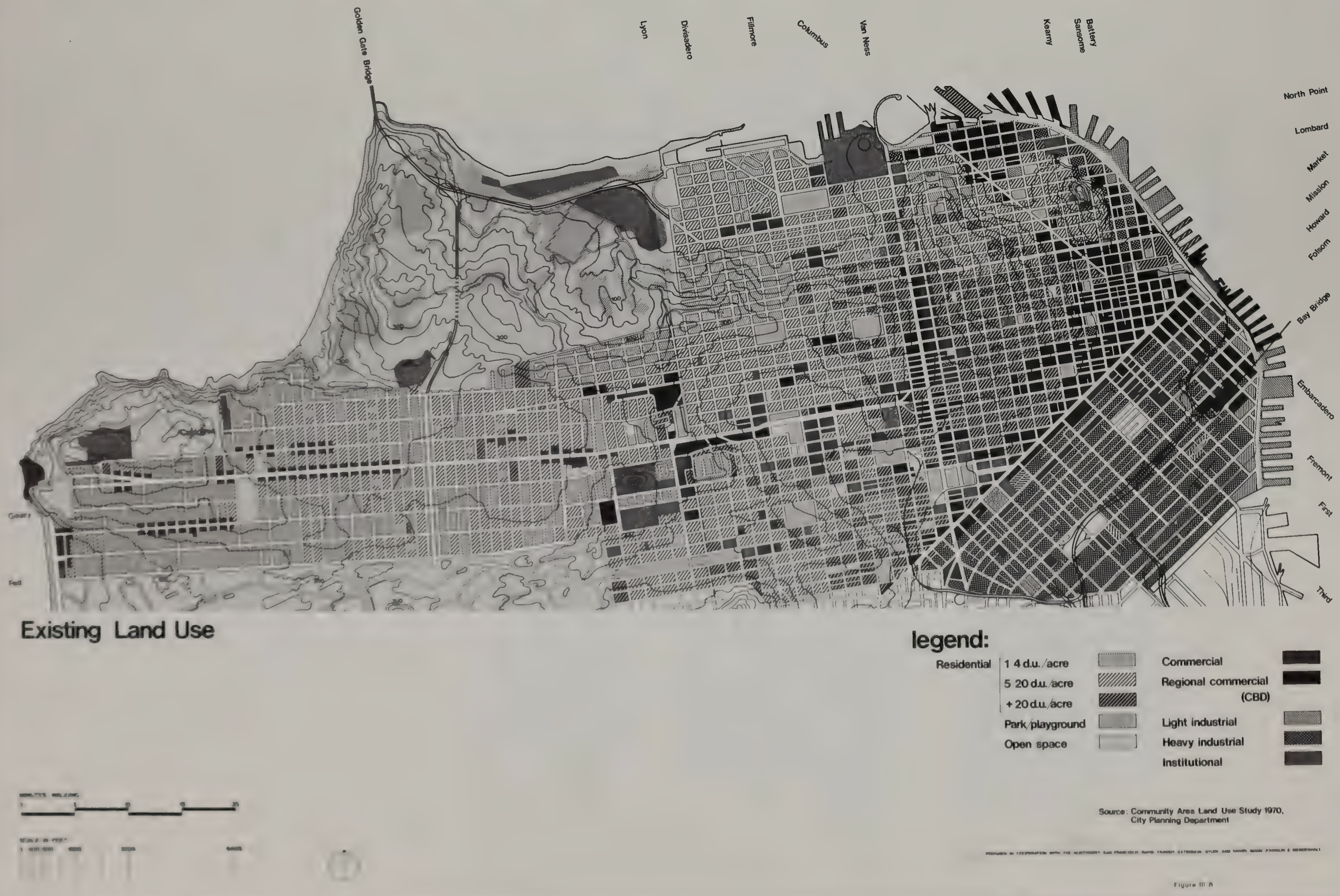
Employment centers ▨
Hospital/health care *
Colleges ⊙
Regional recreation ●

Source City Planning Data

Figure III 7

8. Existing Land Use

The Corridor is primarily composed of medium and high density residential land uses, generally divided by neighborhood commercial areas located on major arterial streets. The Corridor's major commercial area is the Central Business District which is composed of office, retail, and institutional land uses. There are a number of open space areas in the Corridor, including the Presidio, Golden Gate National Recreation Area, and Golden Gate Park. The map which follows identifies predominant existing land use in the Corridor.



Existing Land Use

Source: Community Area Land Use Study 1970,
City Planning Department

Figure III 8

9. Development Regulations and Zoning

Allowable future land use and building form in the Corridor are regulated by certain controls, including zoning and building height and bulk regulations. Zoning regulates the permissible land uses and activities which can exist in any area. Generally, zoning regulations are designed to protect the existing residential character of San Francisco's neighborhoods and prescribe that major future commercial land use be concentrated in the Central Business District. Highest density commercial zones are in the existing Financial District. Corridor allowable zoning is indicated on the map on the following page.

Height and bulk regulations set standards for future building form. Underlying these regulations are San Francisco policies to enhance and preserve the City's unusual scenic and topographic resources. These regulations generally call for buildings over 40 feet in height to be restricted either to the Central Business District at the eastern end of the area or to major neighborhood activity centers and hilltops in residential areas. These regulations emphasize existing topography and protect views of the bay, ocean, and city. Allowable height and bulk regulations in the Corridor are indicated in Figure III-9B.

Information about development controls is important in transportation planning because it is the principal indicator for the City's future form. It is useful in predicting where transit routes should be located to serve the future employees and residents of new buildings. A summary of development controls in the Corridor is indicated on Table III-2.

TABLE III-2

DEVELOPMENT CONTROLS SUMMARY

Zoning District	Predominant Use	Floor Area Ratio*
R-1-D, R-1, R-2	One and two family dwellings	Maximum coverage, yard and heights limits govern
R-3, R-3.5, R-3-C, R-3.5-C	Multiple family dwellings not to exceed 3 dwellings	
R-4, R-5, R-4, R-5-C	Multiple story and multiple family dwellings	4.5 to 10.0 plus 25% possible bonus
C-1, C-2	Neighborhood and community retail business or services	3.8 - 4.5 plus 25% possible bonus
C-3-0	Downtown offices and commercial	14.0 plus development bonuses
C-3-R, C-3-G, C-3-S, C-M	Downtown support and heavy commercial	7.0 - 10.0 plus bonuses
M-1, M-2	Light and heavy industry	5.0 plus bonuses

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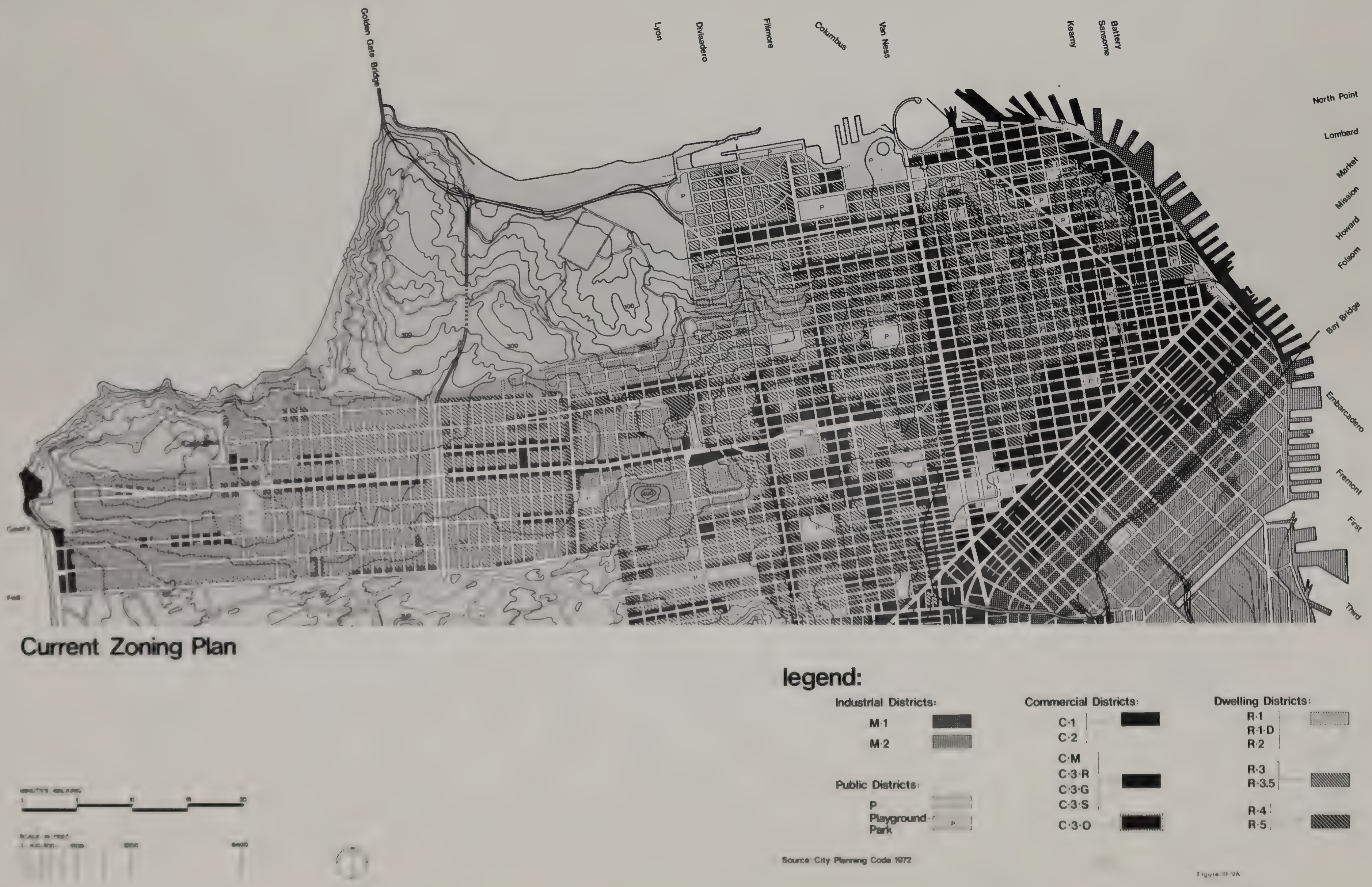
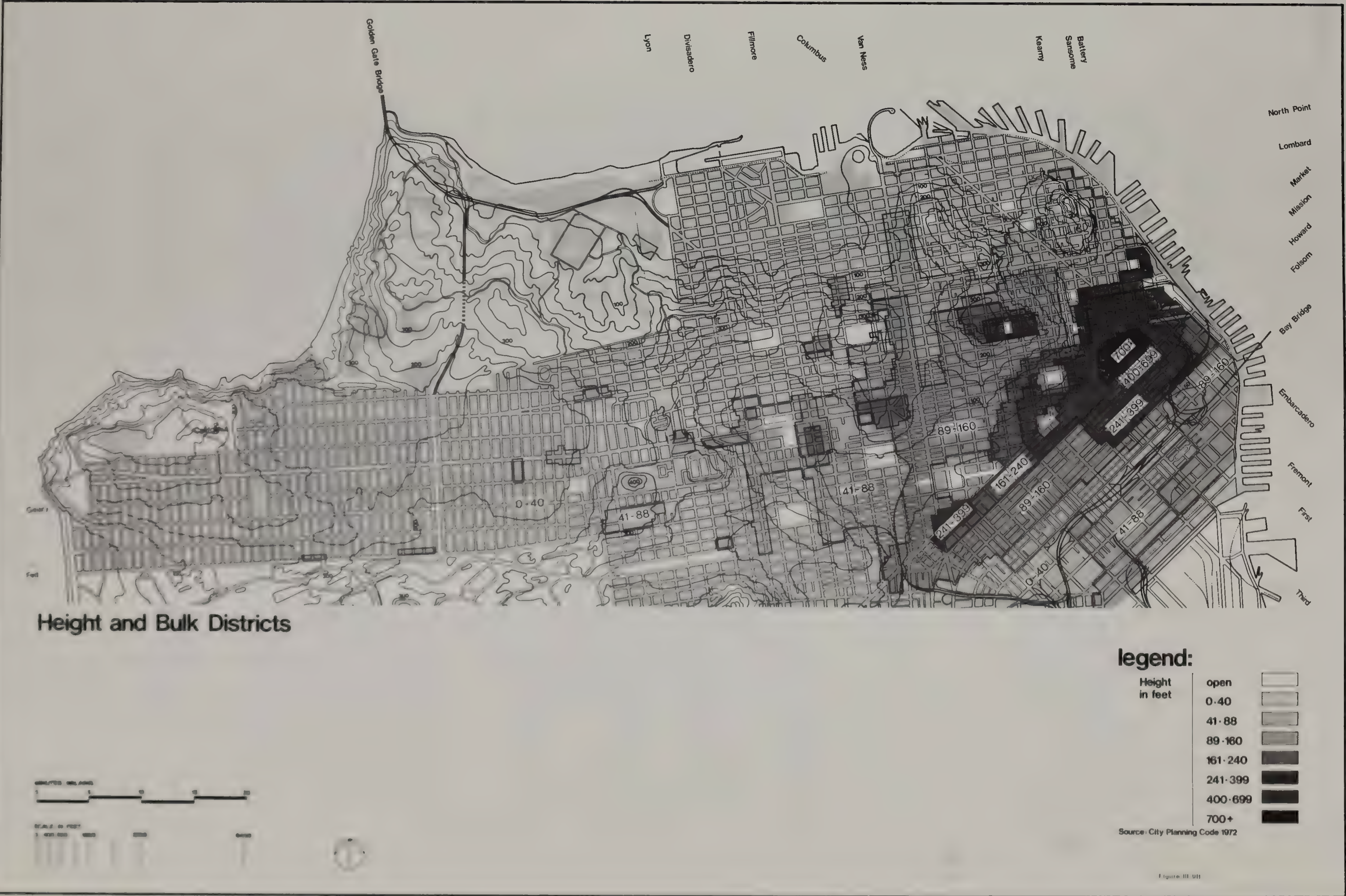
*Floor Area Ratio is allowable building area.



Current Zoning Plan

Source City Planning Code 1972

Figure III 9A



Height and Bulk Districts

Source: City Planning Code 1972

Figure III-[illegible]

10. Development Potential

A principal influence affecting the marketability of new commercial development in the Corridor is the availability of land, either currently vacant or occupied by structures which are relatively impermanent or "susceptible to change." An analysis was made to identify these areas of development opportunity. City blocks were classified in terms of their expected life or permanence. Factors considered were:

- Existing residential land use
- Zoning
- Vacant land
- Assessment ratio of improvements to land value less than 1.0
- Committed or planned development projects

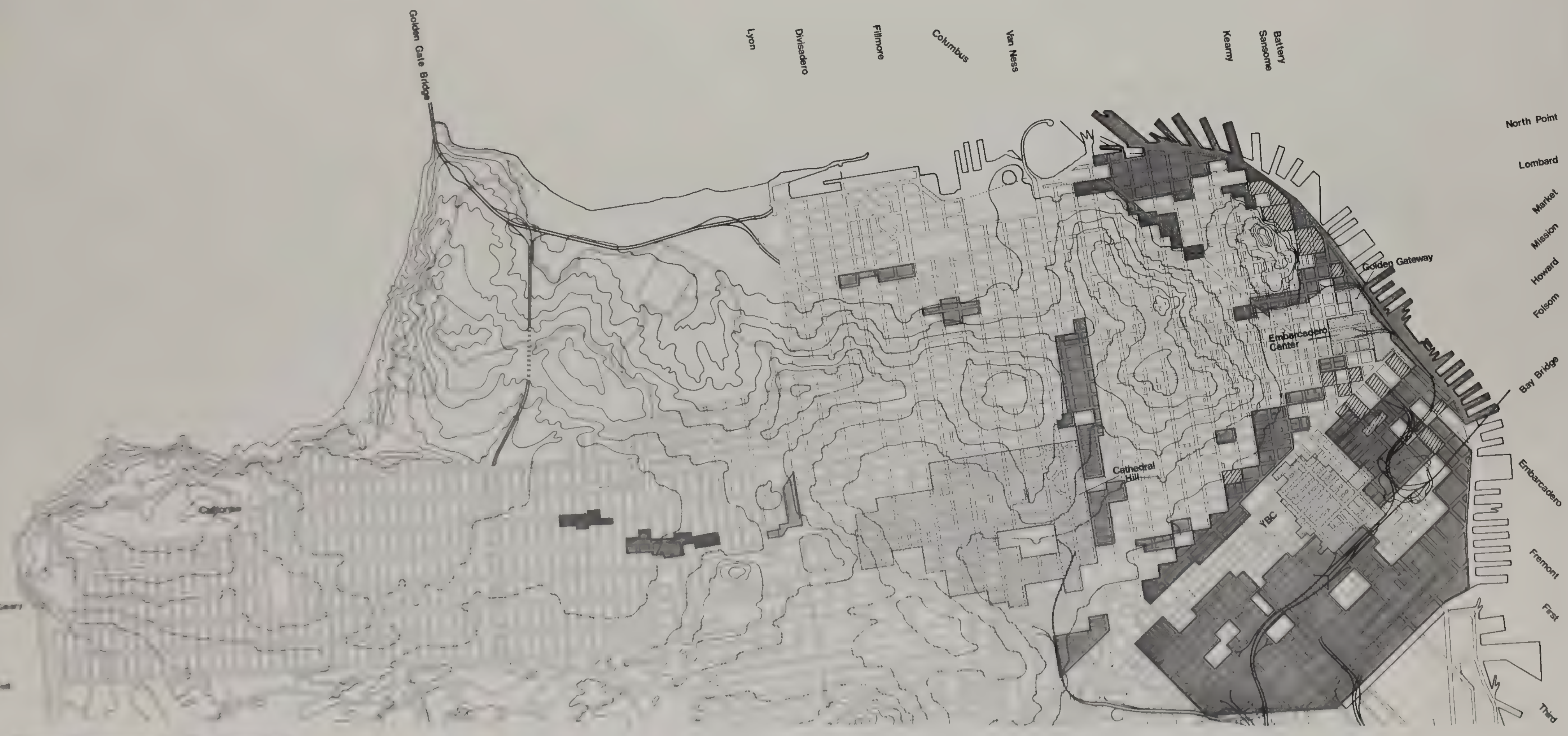
As a first step in the analysis, it was assumed that all existing and zoned residential land use areas were permanent. Therefore, residential areas were excluded from the susceptibility to change analysis. The life expectancy of residential land is not so tied to structural conditions and market forces as commercial land, but more to public policy. In San Francisco where additional housing is vigorously sought, particularly for low income groups, any displacement is socially undesirable. It is important to point out that residential land may be susceptible to change in certain areas even though these areas have been deleted from this analysis. For instance, the South of Market area contains considerable housing which is functionally inappropriate to the surrounding land uses as well as being a marginal economic investment as the Central Business District expands and land values escalate.

The second step was to include all vacant land in the development potential map. The third step was to calculate the ratio of the assessed value of improvements to the assessed value of the land for every block in the study area. For those blocks where the assessed value of the improvements in the block was less than the assessed value of the land, the block was classified as underutilized and included on the development potential map. A final step was to locate all committed or planned projects in the study area.

Analysis of planned and proposed projects indicates that the future development thrust is directed to the South of Market area

stimulated by availability of underutilized and vacant lands, easy access to Market Street BART stations, lower land costs than other areas in or near the Financial District, and the presence of the Yerba Buena Center Redevelopment Project. This implies a further intensification and spreading of the Financial District. Historically, the Financial District has been the central office and commercial core area of the City. However, there is some indication that the Civic Center area may emerge as a second major office core area in the Corridor due primarily to the increased access provided by BART, expanding government employment, and availability of low cost building sites. To a lesser extent, other areas of development potential are the Northern Waterfront area and some intensification of neighborhood retail activities along major arterial streets in the Corridor.

For transit planning, this analysis together with development control data provides a guide to the selection of transit routes which will serve areas of future development potential.



Development Potential

legend:

Areas of opportunity	■
Committed/planned projects	▨
Redevelopment areas	□

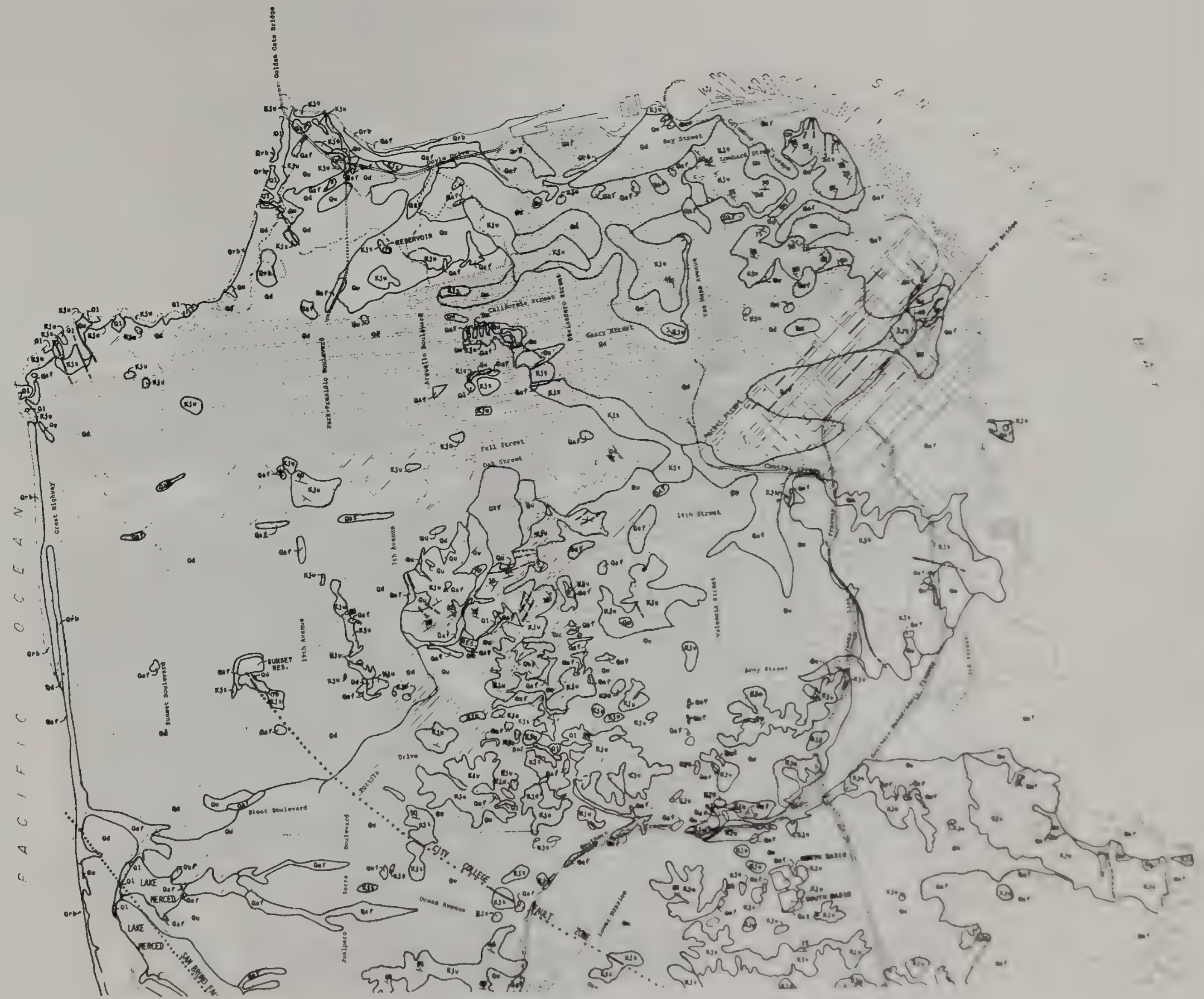
Source City Planning Data, Assessors Block Data, Redevelopment Agency, Wells Fargo Bank, Coldwell Banker, SPUR High rise Study, 1970 Census, 1965 Zoning Study, WMRT Field Inspection

Figure III-10

11. Geology

Earthquake damage to structures may result from intense shaking or from soil and rock failures. Such damage may also be caused by differential ground movement on opposite sides of a fault. The intensity of earthquake shaking is strongly influenced by the type of soil or rock underlying an area, and the possibility of ground failure is primarily determined by the soil and rock types present. The location of faults that might move during an earthquake defines the possible hazard due to surface rupture.

The geologic map, Figure III-11, shows the location and extent of the major geologic formations in San Francisco that have distinctive engineering characteristics. The geologic character of the City is important in transit route planning to determine construction methods, capital cost, and risk to structural damage.



EXPLANATION

- Recent / Pleistocene — QUATERNARY
  - **Qaf** Artificial fill: Predominantly dune sand but includes silt, clay, rock waste, man-made debris, and organic waste
  - **Ql** Landslide deposits: Generally unstratified mixtures of rock, sand, silt, and clay in varying proportions.
  - **Qrb** Beach deposits: Predominantly well-sorted medium- to coarse-grained grey sand, may be coarse gravel and large cobbles
  - **Qd** Dune sand: Clean, well sorted, fine- to medium-grained sand, light grey except for local concentrations of black sand in ripple troughs
  - **Qu** Quaternary deposits, undifferentiated: Includes Colma formation of unconsolidated sand and clay, alluvium, slope debris, and bay mud, less commonly includes dune sand, beach deposits, landslides, and fill
- Franciscan group — JURASSIC AND CRETACEOUS
  - **Kju** Undifferentiated Franciscan group rocks, including serpentine, greywacke (sandstone), chert, greenstone, shale, gabbro, diabase and minor quantities of metamorphic rocks. The rocks may be more or less weathered and vary from thinly bedded to massive. Fracturing may vary from slight to intense
  - **Kjs** Intensely sheared Franciscan group rocks. Sheared rocks are relatively soft, friable and contain large quantities of clay minerals

Geologic contact

Fault, dotted where concealed

Strike and dip of bedding

EARTHQUAKE STABILITY

Artificial fill (Qaf)	Very low stability where placed over soft bay mud. Moderate to high stability where well compacted on firm base
Landslide deposits (Ql)	Very low stability
Beach deposits (Qrb)	Low stability due to liquefaction potential
Dune sand (Qd)	Moderate to high stability except for local liquefaction potential
Quaternary deposits, undifferentiated (Qu)	Stability variable from low to moderate
Franciscan group rocks, undifferentiated (Kju)	Generally high stability
Intensely sheared Franciscan group rocks (Kjs)	Low to moderate stability depending upon degree of saturation, shearing, and abundance of clay minerals

ENGINEERING GEOLOGIC MAP
OF SAN FRANCISCO

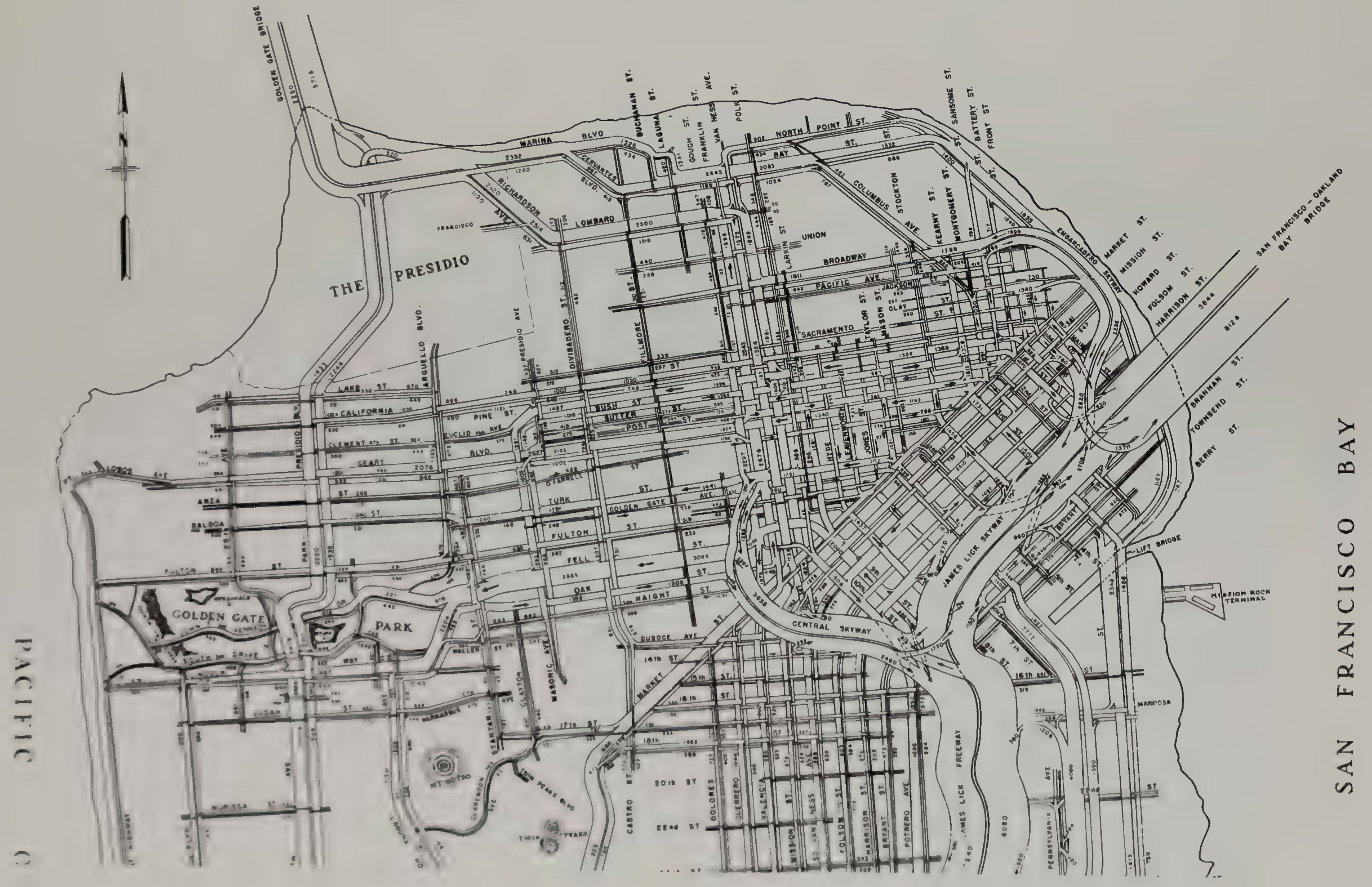
SAN FRANCISCO SEISMIC SAFETY INVESTIGATION
GEOLOGIC EVALUATION

[illegible]

FIGURE II. 11

12. Street and Highway System

Vehicular traffic in the Corridor is primarily served by the City surface street system. Freeways within the Corridor include the Central Freeway and The Embarcadero Skyway, which provide access to the San Francisco Central Business District from the Peninsula and the East Bay. Major arterials from the Central Business District to other parts of the City include Market Street, Geary Boulevard, Van Ness Avenue, Columbus Avenue, Sansome/ Battery Streets and The Embarcadero. Other major arterials which carry heavy traffic volumes in the Corridor are Broadway, Bay Street, Lombard Street in the east-west direction and Park-Presidio Boulevard, Masonic, and Divisadero in the north-south direction. These arteries often form the edge or boundary between residential neighborhoods and commercial districts. Evening peak hour traffic volumes in the Corridor are shown in Figure III-6B.



CITY & COUNTY OF SAN FRANCISCO
EVENING PEAK HOUR TRAFFIC FLOW
ON PRINCIPAL STREETS & HIGHWAYS
1969 - 1973

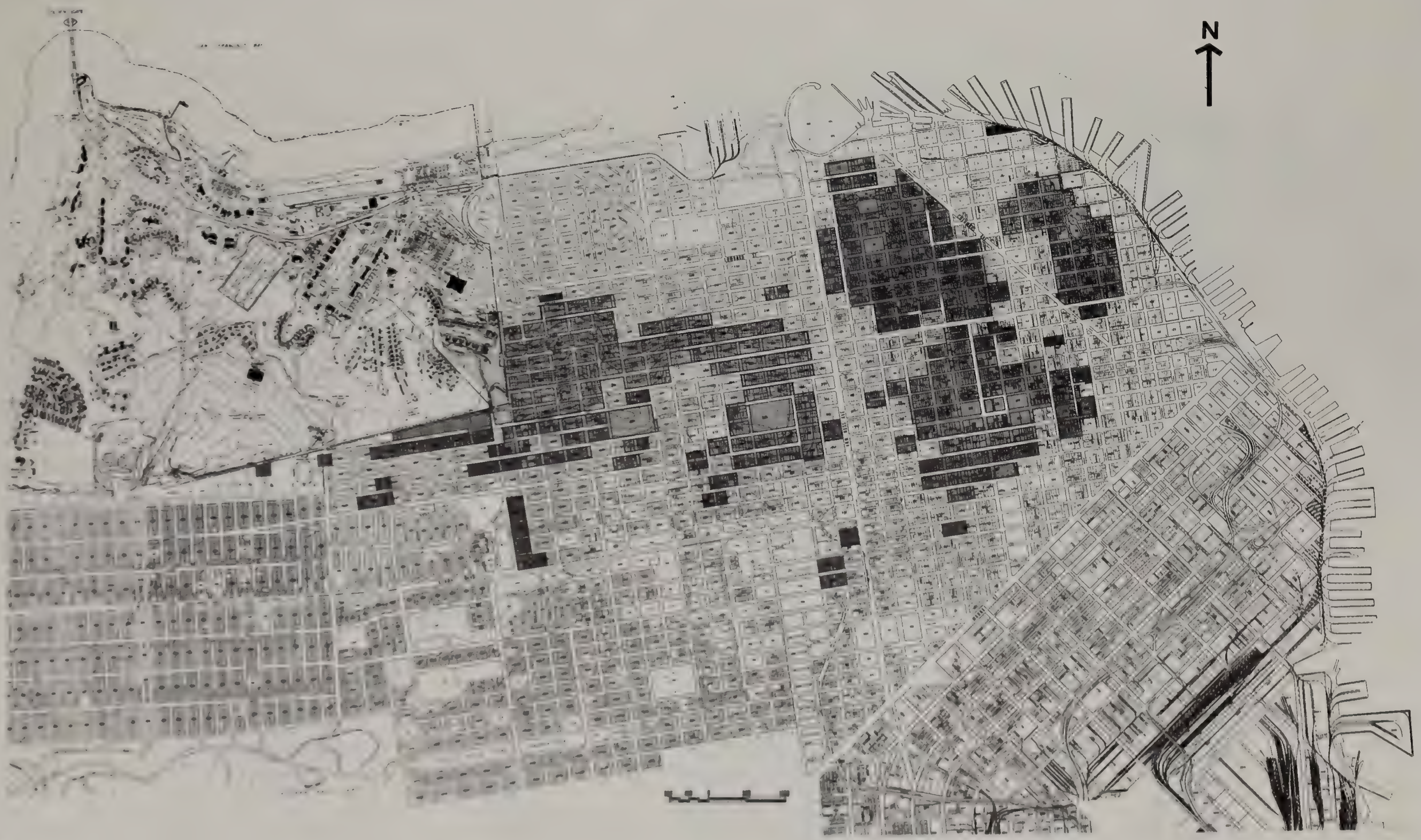
DEPARTMENT OF
PUBLIC WORKS
BUREAU OF ENGINEERING
DIVISION OF
TRAFFIC ENGINEERING
DRAWN BY YTP JULY 1973

FIGURE III-12

13. Limiting Street Gradients

The streets chosen for the Golden Gate Transit bus surface routes must have a suitable gradient; too steep gradients will result in slow bus operation. Based on the performance of the Golden Gate Transit System bus vehicles the limiting gradient has been established at 10%. Therefore, any streets within the Corridor having gradients of 10% and above are considered infeasible for potential Golden Gate Transit bus routes.

To assist in the selection of possible surface bus routes, areas with street gradients of 10% and above were identified and shown shaded on the following map of the Corridor. This identification has generally been limited to that part of the Corridor lying to the north of Geary Boulevard.



AREAS WITH LIMITING STREET GRADIENTS - 10% AND ABOVE

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FIGURE III-13

C. CRITERIA

Another step in the process of developing a basis for route selection is the establishment of the characteristics of the transit system: What it should do in terms of transit service and what it should not do in terms of undesirable effects on the neighborhoods through which it passes.

To obtain desirable effects and to minimize negative impacts, detailed standards were prepared. These criteria fall into the following three categories:

- Transit System
- Urban Planning
- Environmental

The criteria were reviewed by the Technical Advisory Group and the Citizens Advisory Panel prior to review and approval by the Board of Control. Considerable interest was shown in development of the criteria and a number of additions and modifications were made by these bodies as a result of their study. The main criteria are summarized in this section. The complete texts, as approved by the Citizens Advisory Panel, Technical Advisory Group, and the Board of Control, are in the Appendix.

1. Transit System

The transit system criteria govern the route location, transit-way dimensions and clearances, transit service, and matters pertaining to rider comfort and safety. Certain criteria are not applicable to surface route alternatives.

a. Transit-Way

A major difficulty in preparing the criteria was the requirement that the transit-way be designed to accommodate the present bus fleet of the GGBHTD and also be convertible to the use of fixed guideway vehicles, without specifying what the fixed guideway system will be. The criteria pertaining to the fixed guideway system are somewhat arbitrary, but, in general, are similar to BART requirements with respect to size, clearances, guideway curvature, and grade and loads on structures. These criteria will also accommodate most other fixed guideway systems which would be suitable for Golden Gate transit service.

Wherever possible, transit-way geometrics were set to accommodate a minimum design speed of 40 mph and a maximum speed of 80 mph, as governed by the location of curves, station stop spacings, and performance characteristics of the vehicle system.

The minimum radius for horizontal curves was established at 610 ft. This corresponds to the minimum design speed of 40 mph.

The maximum main line sustained grade was set at 3%, with 4% allowed for distances of 1,000 ft, or less. The maximum grade for bus access ramps and temporary connectors is 10%.

The typical transit-way has been planned to have two lanes, one for each direction of traffic. For below-grade applications, the lanes will be either in one structure, or in two separate structures, accommodating one lane each. The lane width in subway is a minimum of 13 ft.

b. Ventilation

The criteria requires that transit-way tunnels be ventilated by air moved longitudinally through the tunnel by fans. Ventilation fans have been sized to move sufficient air to provide a complete air change at least once every three minutes. This will provide air of the quality described in the environmental criteria below, under the conditions of operation likely to produce the highest concentration of exhaust emissions that occur using the GGBHTD diesel buses. When the current fleet of buses is replaced by those meeting 1975 Emission Standards, the air change frequency can be changed to once every five minutes by reducing fan action.

c. Fare Collection -

The fare collection criterion requires a register-type system, carried on the bus and operated by the driver. The machine issues tickets and records each transaction. Space will be provided at passenger stations for installation of fare collection facilities, including turnstiles, ticket-vending machines, and change-making machine, as required for fare collection if the system is changed to fixed guideway.

d. Bus Vehicle

Current planning contemplates the initial use of the present GGBHTD buses, which are 40-ft long, 8-ft 6-in. wide and 10-ft, 4-in. high, with 45 passenger seats, and a gross overall weight of 32,000 lbs. The interior celing height is 6 ft 4 in. and the bus is capable of a top speed of not less than 65 mph on straight level road.

e. Service

The system was planned to provide service seven days a week. Workday service was designed to meet the average passenger demand and provide all passengers with seats. Recreation service was planned to meet forecast service demands on weekends and holidays. A standard for measuring alternatives against this criterion is that service levels shall not be below current service levels at any point in the system.

f. Station Circulation

Station access and passenger circulation facilities are planned to accommodate the forecasted patronage. Escalators will be provided in those stations where stair height in the up direction exceeds 12 ft and in the down direction 24 ft. All stations will be provided with elevators and/or ramps to permit access by handicapped persons.

2. Urban Planning

The objectives of urban planning aspects of the project were the creation of a plan for a transit system that will:

- Preserve or enchance social, economic, and environmental characteristics.
- Conform to comprehensive planning; including planning for land use, transit needs, provision for open space, population growth, and special considerations for specific areas.
- Be compatible with regional, county, and local community needs and desires.

- Be consistent with appropriate aesthetic standards for fixed facilities.

To obtain the above objectives, the following urban planning criteria were prepared:

- Minimize the displacement or permanent loss of residents, businesses, and unique or valued activities.
- Minimize disruption of important community physical, social, and cultural activities and uses, both during the transit system construction and its operation.
- Minimize physical and psychological barriers which would divide homogenous neighborhoods and districts.
- Maximize improvement of transit service characteristics.
- Maximize the effectiveness of the transit system in terms of service offered to the transit dependent segments of the population.
- Maximize population and employment patronage served within walking distance of stations.
- Maximize linkage to major activities and principal transportation facilities.
- Maximize conformance to general plans which have been adopted by public agencies setting forth policies for growth and preservation of the environment.
- Maximize the potential of transit-generated urban development.
- Maximize compatibility of the transit structures with the Corridor urban design characteristics.
- Maximize the view of the transit system rider in terms of pleasant visual experiences and the appreciation of scenic resources.

3. Environmental

The criteria established to assess the environmental impact of the alternative transit systems were divided into long-term, or continuing effects, and short-term effects which will occur only during the construction period.

a. Long-Term Effects

(1) Air Quality

The most desirable transit route from an air quality point of view will be the one that results in the least total pollutants emitted by all travel modes. The transit route which reduces auto travel most, by attracting auto riders to transit travel, will be the most effective in reducing air pollution. Therefore, the criterion for air quality is to maximize transit travel and minimize private auto travel.

(2) Noise

The San Francisco Noise Ordinance (Ordinance #274-72) has been adopted as the criterion for noise pollution. The requirements of the ordinance vary with the time of day and the zoning designation from a sound level of 50 dBA to 80 dBA at the nearest property line or at a distance to 50 ft from a transit vehicle.

(3) Land Forms and Vegetation

The objective of this criterion is to minimize the long-term loss of land forms and vegetation and to create more open space, where possible. During construction, the removal of vegetation is to be avoided, where possible, and vegetation that is removed must be replaced upon completion of the construction work.

Bay fill is to be used only for approaches to underwater transit-ways or for reconstruction of waterfront structures displaced by transit-way construction.

Alterations to topography are to be avoided if possible. If necessary, they are to be done in a manner to complement the natural ground contours. The impact of dredging required for subaqueous tube transit-ways is to be identified as to its effect on both water quality and marine ecology.

(4) Micro-climate

The adverse effects resulting from construction of wind barriers, creation of points of emission of heated air, the construction of structures that are barriers to sunlight, and other adverse effects on the micro-climate are to be minimized.

(5) Hydrology and Geology

The construction of transit-ways shall be done in a manner that will not increase the probability of flooding, storm drainage overflow, or create other adverse effects on the hydrology of the area through which the transit-way passes. The location and manner of subsurface construction shall be done in a way to minimize the possibility of damage to existing structures due to vibrations, subsidence or other hydrological or geological disturbances.

(6) Energy Resources

The objective of this criterion is to maximize the energy (fuel resources) conserved through the use of transit; e. g., to create an efficient transit system from the standpoint of fuel requirement, and, as in the case of air pollution, to reduce auto fuel consumption by attracting the maximum number of auto travelers to transit use.

b. Short-Term Impacts

The short-term impact is the degree of disruption to the physical and social environment during construction.

Construction operations must conform to the same noise limits as specified in the San Francisco Noise Ordinance referred to above.

The creation of dust and other air pollutants at points of construction activity must be minimized. Impedance to traffic flow in construction areas must be identified and minimized.

The available disposal sites and amount of excavated material and construction waste that must be disposed of must be examined and considered in the route evaluation.

SECTION IV

Many possible route alignments were considered for the subsurface routes. The routes which met the two criteria above and were later analyzed and evaluated are shown in Figure IV-1. The routes generally fall into one of four groups. Group A were those routes in the Geary Corridor, the Group B routes are those in the Lombard Corridor; the Group C routes are along the Marina and Group D are subaqueous tubes from Marin County to San Francisco.

2. Low Cost, Minimum Disruption Alternatives (Surface Routes)

The alternatives in this group all utilized surface streets and therefore are referred to as the Surface Routes.

The surface routes were grouped by concept into single routes and dispersed routes. The single route concept provides preferential treatment for buses on city streets along a single route alignment. The dispersed route concept uses multiple routes for buses on city streets without preferential treatment. The surface routes analyzed and evaluated are shown in Figures IV-2 and IV-3.

B. ANALYSIS OF ALL FEASIBLE ROUTES

The objective of the analysis was to provide information concerning the criteria and the policies (discussed in Section III) for each alternative. This information would be the basis for comparing the routes.

A matrix was developed containing the information for the surface route alternatives and another for the subsurface routes. An entry of data was made for each criterion for each route. Where possible a real value was used; e. g. travel time. For those criteria which could not be quantified--for instance, rider experience--a descriptive statement was entered.

The following information was shown on the matrix for each criteria:

- Travel Time

  Minutes from Marin City to Financial District

  Minutes from Marin City to Civic Center

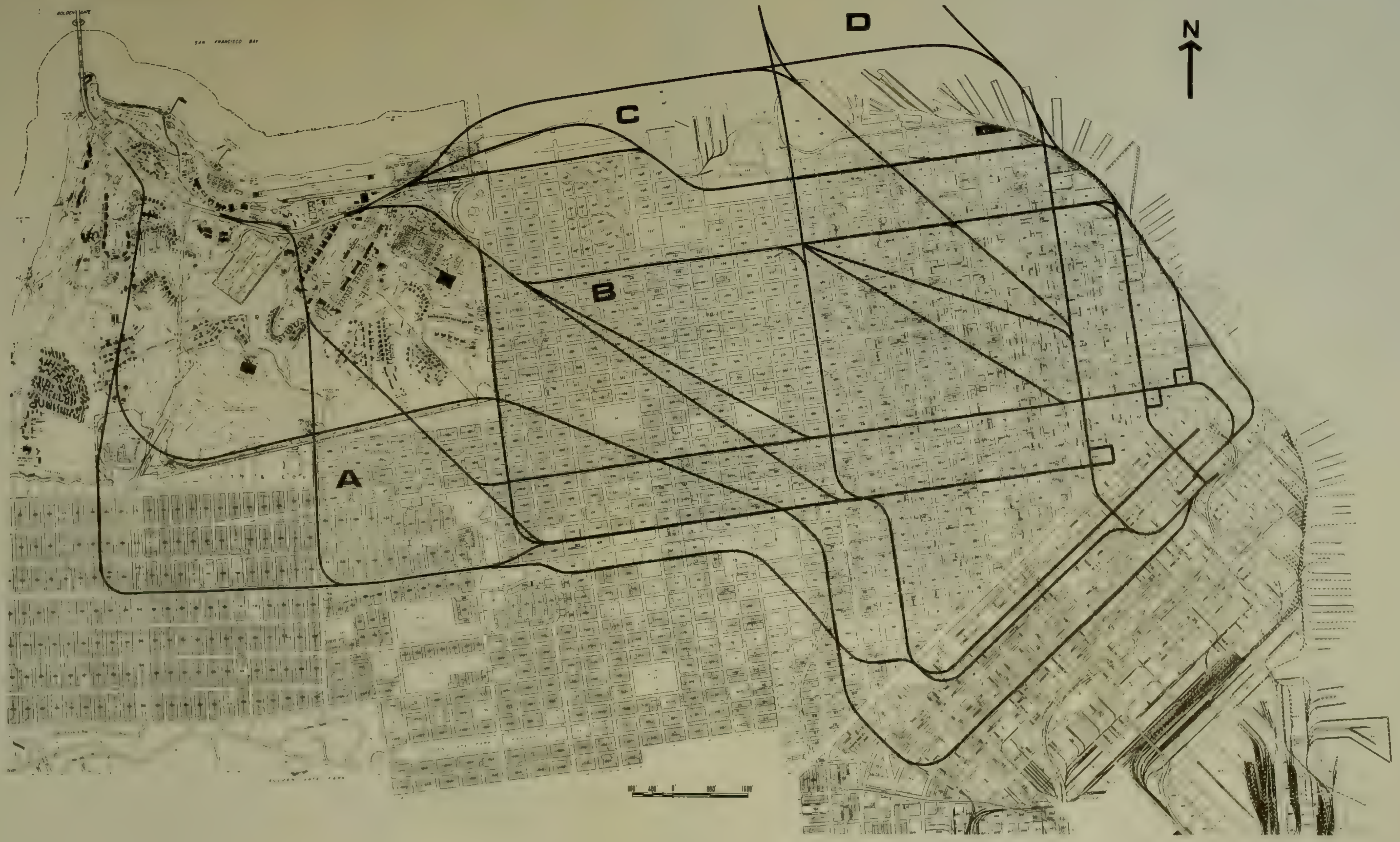

FIGURE IV 1

SUBSURFACE ROUTE ALTERNATIVES

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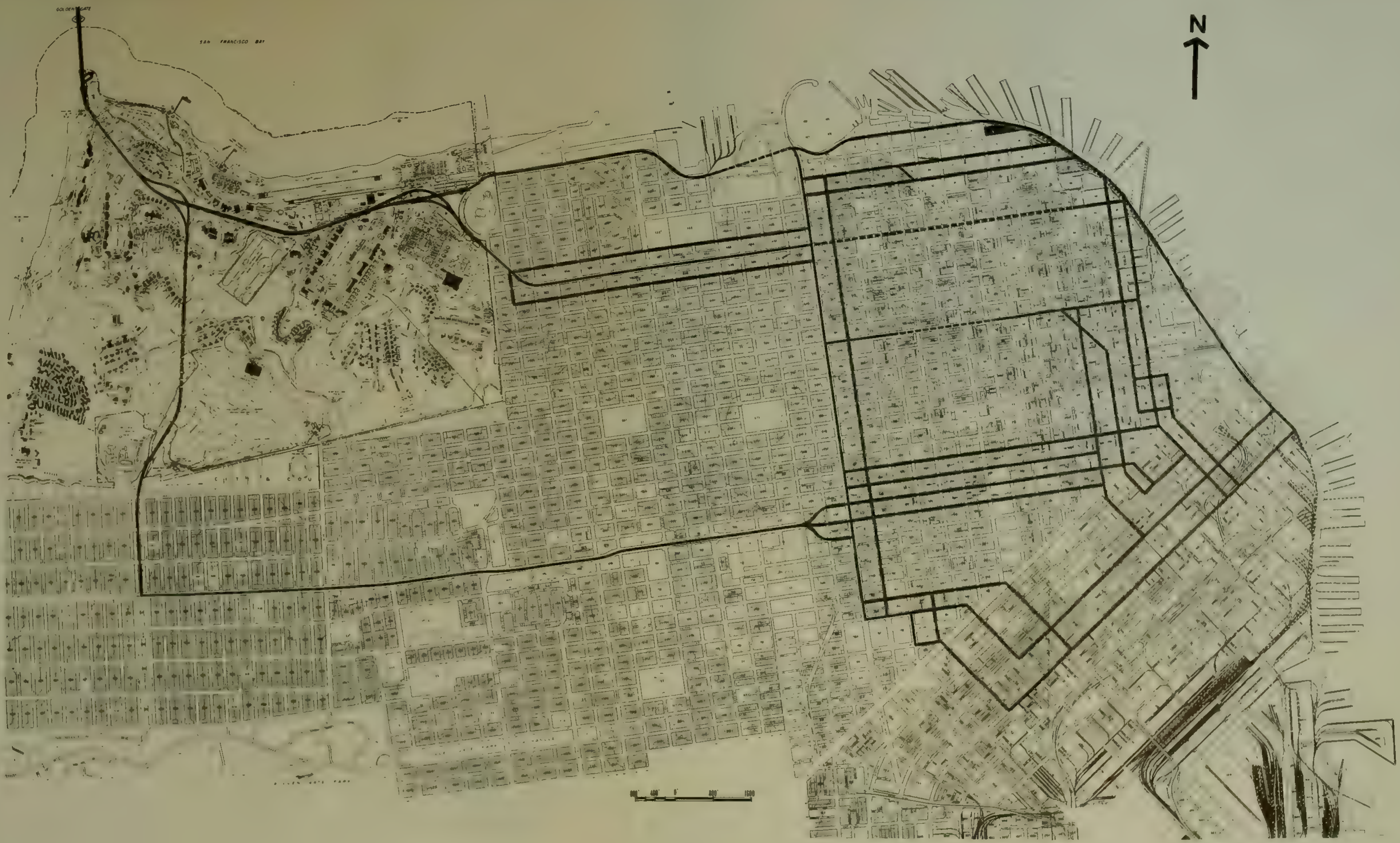

FIGURE IV 2

SINGLE SURFACE ROUTE ALTERNATIVES

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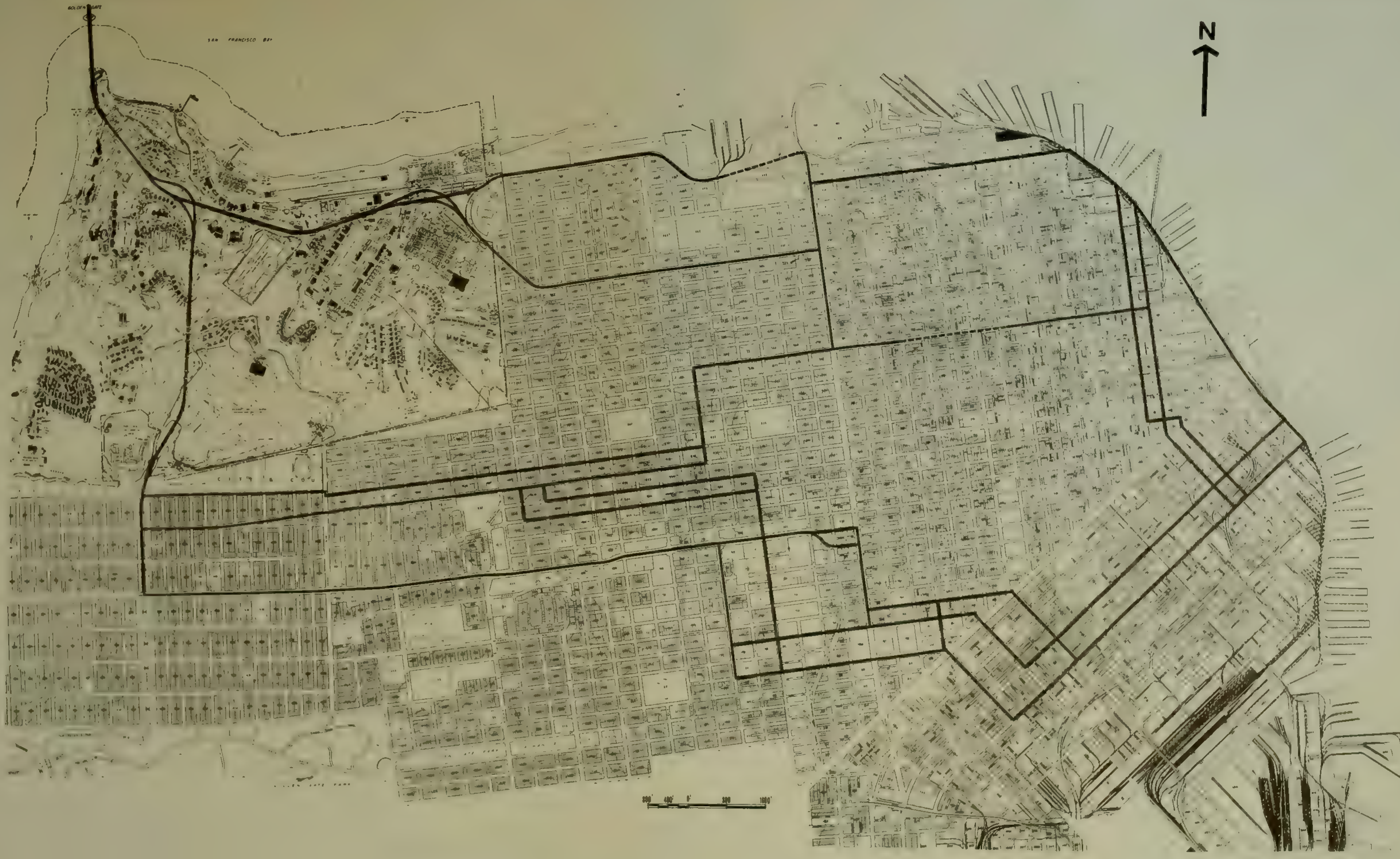

FIGURE IV 3

DISPERSED SURFACE ROUTE ALTERNATIVES

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- Cost Indices

  Capital Cost index

  Operating Cost index

- Implementation

  Total implementation time

- Staging Considerations

  Number of stages possible

  Number of options for continuing construction at the end of each stage

  Conditions of interim operation at the end of each stage

- System Extendibility South of Market Street

  Degree of difficulty of extending the right-of-way across Market Street, as a fixed guideway system

- Joint Use with MUNI

  Number of MUNI lines which could be operated as an express service in the transit right-of-way

- Weekday Patronage

  Preliminary estimate of weekday patronage for 1990

- Air Pollution

  Amount of air pollution emitted by commute autos and buses crossing the Golden Gate Bridge during an average weekday

  Micro-climate impact

- Noise

  Number and location of residences and activities affected by noise from the transit system

- Traffic Impact

  The reduction in the number of autos in San Francisco due to increased bus travel

  An assessment of traffic disruption added by Golden Gate bus traffic on San Francisco streets

- Natural Resources

  Location and amount of vegetation displaced

  Location and nature of land forms altered

  Energy--a factor of fuel saved from reduction in gasoline consumption due to increase in bus ridership

- Construction Disruption

  Number and extent of impact areas measured by the length of construction zone

  Number of activities impacted by type

  Location, degree, and duration of parking and traffic disruption

  Amount of spoil to be disposed

  Degree of possible damage due to subsidence during tunnelling work

- Accessibility

  Number of people within a five-minute walk of Golden Gate bus stops, including subtotals for employment, transit dependent and residential population

  Number of special activities within a five-minute walk of Golden Gate bus stops

  Number of points for transfer to other transit systems

- Residential Displacement

  Number of dwelling units displaced

  Total population displaced

- Nonresidential Displacement

  Number of special activities affected

  Number of business establishments displaced

  Total employment displaced

  Description of other disruption

- Development Potential

  Description of potential development

  Description of possible transit generated development

- Rider Experience

  Description of the view and pleasantness of ride

- Appearance of the System

  Description of the visible structures

- Conformity with General Plans

  Description of any conflicts

C. EVALUATION OF ALL FEASIBLE ROUTES

The information on the matrices was then used to evaluate the routes and select those routes which best satisfied the criteria. This evaluation was carried out by two methods:

- A numerical evaluation in which a score was calculated for each route in comparison with other routes.

- A subjective evaluation which compared routes and successively eliminated those with less desirable features.

The numerical evaluation was used in evaluating the subsurface category of alternatives because over 40 routes were analyzed against 60 criteria. The surface alternatives were refined to a smaller number through the initial screening. Only seven single surface routes and six dispersed surface routes were analyzed in the matrix. Thus, the subjective evaluation method alone was sufficient to select the surface alternatives.

1. Numerical Evaluation

The numerical evaluation was conducted by rating each route with respect to the other routes within each criterion and then by rating the criteria in relationship to each other.

To rate each route within each criteria the actual value was used where possible, e.g., travel time or cost. Where ratings could not be directly quantified, a subjective relative index of 0 to 100 was used.

A weight was also assigned to each criterion to reflect its relative importance. This assignment of weights was done 28 different times, to emphasize the importance of different criteria. This technique forced the consideration of the desires of various interest groups and prevented the generation of a mathematical score with an intrinsic bias. For example, criteria weights were developed from the point of view of the Marin/Sonoma Transit commuter and the San Francisco resident along the route alternative. Six sets of the criteria weights were developed by the members of the Citizens Advisory Panel (CAP) and both the CAP and TAG reviewed the route ratings, criteria weights, and the overall mathematical analysis.

The route rating entry was multiplied by the criteria weight and the products for that route were summed across the matrix.

2. Subjective Evaluation

In addition to the numerical evaluation of each route, a subjective comparison method was used. In this method, each route was again evaluated against each criteria but on a subjective comparison basis. The selection of certain routes and the elimination of others

occurred as the comparison showed up those routes which were more desirable.

There were five criteria which generally caused an alternative route to be eliminated from further considerations. These were:

- Longer travel time compared to other routes with similar cost and impacts.
- Excessive long-term neighborhood impacts compared to other routes with equivalent service and cost.
- Excessive capital cost compared to other less costly alternatives which provided equivalent service and impacts.
- Excessive construction disruption compared to other routes with similar service and cost.
- Bay Conservation and Development Commission policy against offshore routes when similar onshore routes are possible.

Seven single surface routes were evaluated. One was eliminated because of the excessive capital cost. Two were eliminated because of excessive travel times. Two alternatives, nearly identical, were combined to optimize their advantages. This selection process left three single surface routes for final analysis.

Six different dispersed surface routes were analyzed. Two were eliminated because of excessive travel time. Three were eliminated because of excessive neighborhood impacts. This left one dispersed alternative for final analysis.

Five subsurface routes in the Geary corridor (Group A) were evaluated for joint-use opportunity in conjunction with the NWX Study. Two alternatives were eliminated because of excessive travel time and construction cost. One alternative was eliminated because of the severe impact on Presidio property. The remaining two alternatives were generally similar and the final selection was based on slightly lower travel time and cost and less disruption. The reason for considering alternatives in the Geary corridor was to determine whether the construction of a joint-use corridor providing rapid transit service for MUNI and Golden Gate patrons would reduce costs. In fact, however, the Geary corridor subsurface route selected was more costly than the other subsurface routes. In order

to select the best overall routes for final analysis and still continue consideration of a joint-use corridor, a Golden Gate surface route providing transfer capability to the Muni service in the Geary corridor was later substituted for the selected subsurface route.

Of the 13 subsurface routes in the Lombard corridor, (Group B), nine were rejected because of excessive travel time, excessive cost, or excessive construction disruption. The remaining four routes were generally similar except that the two selected had virtually their total alignment in public rights-of-way, thus minimizing residential displacements.

All of the subsurface routes in the Marina corridor (Group C) were eliminated. Most of these routes were eliminated because of the BCDC policy of choosing an onshore route over offshore route wherever possible. The remaining routes were eliminated because of excessive travel time, cost, or neighborhood impact.

All of the subaqueous tubes routes to Sausalito (Group D) were eliminated because of BCDC policy conflict, strong Marin County objection to the developmental impacts, aesthetic impacts, and excessive capital cost. However, the CAP strongly recommended that a tube route alternative be selected for further study, since a tube would provide an attractive level of service and would minimize San Francisco neighborhood impacts. A tube route terminating in Marin City was then developed.

D. SELECTION OF ALTERNATIVES

The evaluation process resulted in the selection of eight alternatives for final analysis, three single surface routes, one dispersed surface route, two single subsurface routes, one subaqueous tube route, and one route planned in the NWX Study for the Geary corridor. These alternatives are described in detail and graphically presented in Section V. The eight alternatives are grouped into the following five concept categories:

- Single Surface Route

A single surface route to the Transbay Terminal via reserved bus lanes on Lombard Street, Van Ness Avenue, North Point/Bay Streets, The Embarcadero, and Battery/Sansome Streets. This alternative includes express service on The Embarcadero from North Point/Bay streets to the Transbay Terminal. Two options

are available on the North Point/Bay Street section -- a one-way couple with reserve bus lanes and a reversible bus lane on North Point Street. An underpass at Lombard and Van Ness in lieu of a reserved lane on Van Ness Avenue, and a single lane tunnel under Lombard Street, from Lombard and Van Ness to Lombard and Battery Street were also selected as alternatives to be further studied with the single surface route alignment.

- Dispersed Surface Route

A dispersed surface route with operation in mixed traffic using the same city streets as the single surface route described above but adding service in the Geary corridor and through the Broadway tunnel.

- Subsurface Routes

Two subsurface routes were selected. One is a route with surface lanes on Doyle Drive, becoming subsurface at the end of Doyle Drive and continuing in a subway under Lombard Street, Columbus Avenue, and Kearny Street to a major station in the Financial District, continuing subsurface across Market Street, becoming an aerial structure to enter the Transbay Terminal.

The other single subsurface route is the same except the subway alignment continues under Lombard Street to Battery Street, and under Battery Street with the major Financial District station at Battery and Pine streets.

- Subaqueous Tube Route

A subaqueous tube route from a point in Marin County near Highway 101 just north of Sausalito to the northeast corner of the San Francisco waterfront onto a depressed exclusive bus lane along the Embarcadero becoming a subsurface route at Howard Street terminating under the Transbay Terminal.

- Joint Use Facility in the Northwest Corridor

A route utilizing a joint transit facility in the Geary Corridor. The details of this alternative were to be coordinated with the ongoing Northwest Corridor Transit Extension Study and are described in Section V-F

SECTION V

V. DESCRIPTION OF ALTERNATIVES

This section refines and describes in detail the route concepts selected for further study.

The general assumptions and factors which form the basis for the detail description of all the route concepts are presented first. Following that, the selected routes are described within the following five categories:

- SINGLE SURFACE ROUTE - A single alignment with preferential treatment for buses on city streets. Included in this category are the Van Ness Underpass and Lombard single lane tunnel improvements. Various options for the preferential treatment are presented for each segment of the route.
- SUBSURFACE ROUTE - A single alignment with an exclusive transit right-of-way, primarily under city streets, which is adaptable to a fixed guideway system. This concept has two alternative alignments and station locations in the Financial District.
- DISPERSED SURFACE ROUTES - Multiple route alignments in mixed traffic on city streets.
- SUBAQUEOUS TUBE ROUTE - An exclusive busway through a trans-bay tube from Marin County to San Francisco.
- JOINT USE FACILITY IN THE NORTHWEST CORRIDOR - A rapid transit facility shared with MUNI in the Geary Corridor. This concept includes both joint right-of-way and transfer possibilities.

A. GENERAL ASSUMPTIONS AND FACTORS

The detail descriptions of the route alternatives are based on the following assumptions and factors:

1. Traffic Conditions

The traffic service level and capacities of the streets on the bus routes are based on factors and procedures presented in the Highway Capacity Manual published by the Highway Research Board. Only Service Levels C through E are applicable to the streets under consideration in this report and are defined as follows:

- Service Level C--stable traffic flow, but speeds and maneuverability are restricted by moderately high traffic volumes. A relatively satisfactory operating speed and traffic volume that are suitable for design practice.
- Service Level D--approaches unstable flow, with tolerable operating speeds but considerably affected by changes in operating conditions. Fluctuations in volume and temporary restrictions to flow may cause substantial drops in speeds. Drivers have little freedom to maneuver and comfort and convenience are low, but conditions are tolerable for short durations.
- Service Level E--represents operating conditions at lower speeds than Level D with volumes at capacity of the highway. Traffic flow is unstable and momentary stoppages may occur.

2. Patronage Assumptions

The forecast growth in commute (home-to-work) trips between Marin and Sonoma Counties and San Francisco is based on 1990 Population and Employment forecasts for Marin and Sonoma Counties. These forecasts are 333,000 people and 90,000 jobs in Marin County by 1990 and 370,000 people and 110,000 jobs in Sonoma County by 1990. The percent of Marin residents who work, the percent of Marin jobs held by non-Marin residents, and San Francisco's proportional share of Marin commuters are assumed to remain constant from 1970 to 1990. The percentage of the corridor's commuters from Sonoma County to San Francisco is expected to grow proportional to its population. Based on these assumptions, the resulting commuter growth from both Marin and Sonoma between 1970 and 1990 is 45%.

The transit rider total is also projected to increase due to relative travel time changes between the auto and bus. Assuming an average work trip is from San Rafael to the Financial District, an analysis of the modal split curve used in the 1970 Golden Gate Corridor Study indicates that for each minute saved over the existing bus system, transit usage would increase by 0.86%. Travel time changes are expected due to bus improvement north of the Golden Gate Bridge (assumed 10 minutes reduction), increased auto travel time due to congestion (assumed 10 minutes), and the bus travel time savings and service improvements being studied for the routes within San Francisco. A 5% increase in transit is forecast for those routes which increase travel time reliability by separating buses from auto traffic and also provide covered waiting areas in the Financial District.

The patronage forecast for the subsurface alternatives is adapted from the transportation model forecast used in the 1970 Golden Gate Corridor Study, The resulting forecast is slightly higher than might be expected due to travel time alone, primarily due to the higher level of transit service assumed by the model over the surface routes and changes in trip patterns likely to occur with the high level transit service.

The Larkspur ferry patronage was previously forecasted to be 3,200 commuters one-way each day by 1978. The ferry patronage is expected to grow at the same rate as total commuter trips. Half of the ferry patronage is assumed to be attracted from the bus system and half from the auto. The ferry passenger destinations are assumed to be within walking distance of the Ferry Building, thus the percentage of Golden Gate transbay bus patronage destined for the Financial District would decrease from the present 72% to 66% after 1978 when the ferry service starts.

The patronage analysis is detailed in Appendix VI.

3. Bus Volumes

The bus volume during the peak hour assumes 50% of the 1990 peak period patronage occurring within the peak hour and an average load factor of 40 passengers per bus. Current, 1975, Golden Gate, peak hour, bus volume is 104 buses to the Financial District and 30 buses to the Civic Center, for a total of 134 buses.

4. Regional Environmental Impacts

To investigate the regional impact, the following assumptions were made: average commute trip of 20 miles; 1.3 persons per auto vehicle, and 40 persons per bus. Average auto fuel consumption is 13 miles per gallon, and bus fuel consumption is 4 miles per gallon. Based on these assumptions, an estimate is derived of the amount of fuel saved and the reduction in air pollutants in 1990 resulting from the increase in bus patronage due to the route improvements.

The air pollutant reduction assumes that all autos will meet the 1975 emission standards by 1990. Bus emission estimates are based on current Golden Gate bus emissions when operating at 50 mph.

Both the fuel saved and reduced air pollutant numbers are derived from the difference in commuter bus patronage forecast for the given improvements compared to the forecast of a mixed traffic bus system operating in 1990. The difference is assumed to be the number of auto riders attracted to the bus system by the improvements.

Based on these assumptions, the vehicular fuel consumption and air pollutant emissions for an average 1975 weekday in the Golden Gate Corridor are approximately 143,000 gallons of fuel and 24.5 tons of carbon monoxide (CO), 1.09 tons of hydrocarbons (HC) and 2.32 tons of nitrogen oxide (NO_x).

5. Cost Estimates

The estimated construction cost for the various improvements is included in the descriptions. These costs are in January 1975 dollars and do not include escalation to the construction periods. The cost estimates include engineering fees and a 25% contingency. The costs are for bus route improvements within San Francisco only and do not include bus vehicles or assumed improvements west of Richardson Avenue.

The cost estimate detail sheets are included in Appendix VII.

6. Transportation and Operating Benefits

The cost savings to the weekday travelers on the Golden Gate Bridge for each alternative is given in the fact sheet for each route concept.

These benefits are based on the traditional cost benefit analysis of travel time savings to both the auto and bus users in addition to the auto operating cost saving to the persons who switch from auto to bus. Also included are bus operating savings. Further details of these assumptions are given in Appendix VIII.

B. SINGLE SURFACE ROUTES

The alignment selected in Section IV for the single surface route concept is shown in Figure V-1. This alignment is divided into four segments for presentation. Each segment contains various options for preferential bus treatment. The four segments and the various options are:

- DOYLE DRIVE SEGMENT - This segment goes from the Golden Gate Bridge to the eastern edge of The Presidio at Richardson Avenue. The options available for bus preferential treatment on Doyle Drive are not fully developed due to the uncertainty involving the future improvements of this roadway.

- LOMBARD SEGMENT - This segment includes Richardson Avenue and Lombard Street from Richardson Avenue to Van Ness Avenue. The options available for preferential bus treatment are:

  -- A right-hand reserve bus lane
  -- A contraflow reserve bus lane

- VAN NESS - BATTERY SEGMENT - This segment goes from Lombard Street at Van Ness Avenue to Battery/Sansome Streets at The Embarcadero. The alternatives for this segment are shown in Figure V-2. This segment is presented in four sections:

  -- Van Ness Avenue

    - a reserve bus lane
    - a bus underpass

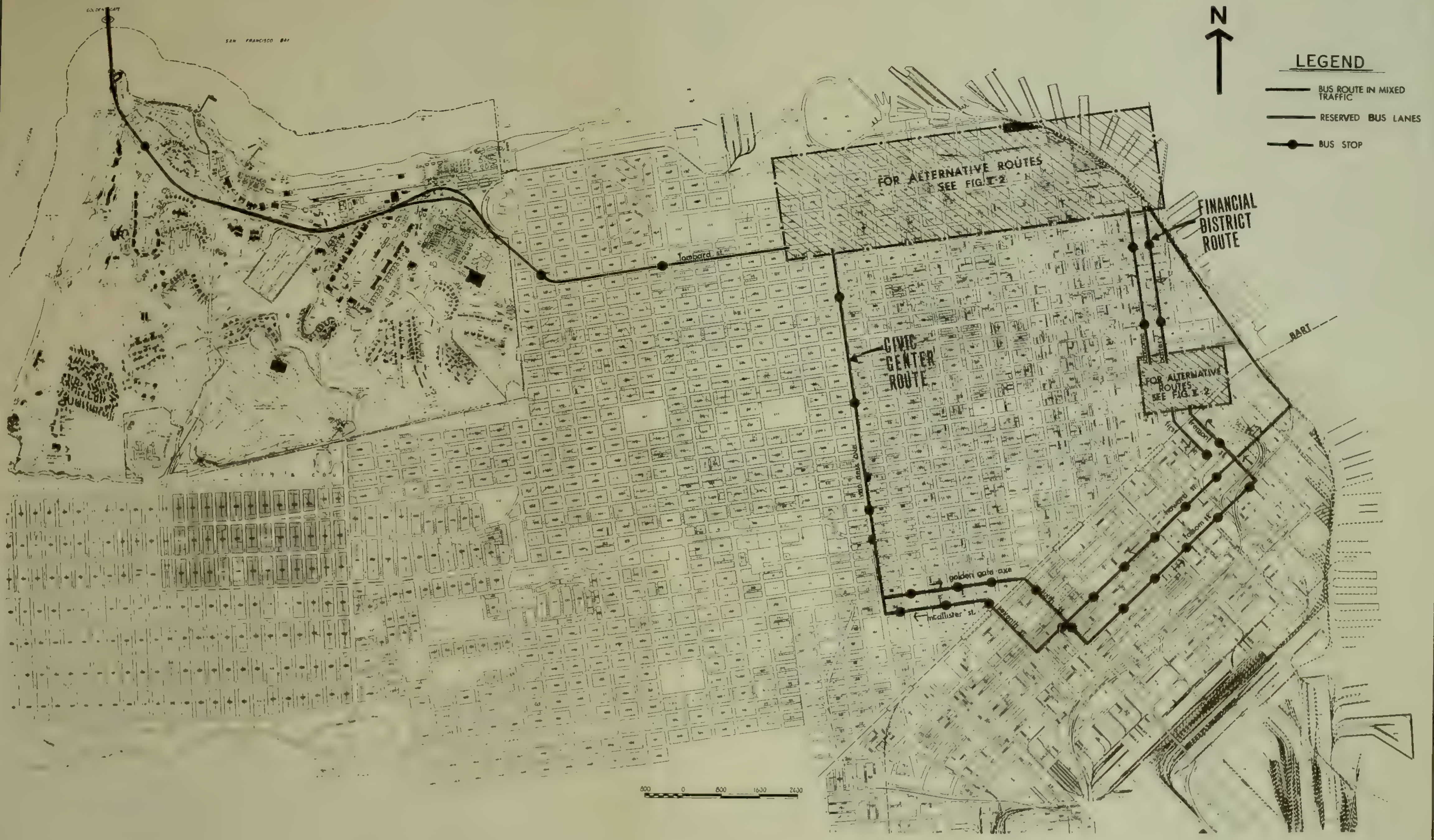

FIGURE V 1

SINGLE SURFACE ROUTE SYSTEM

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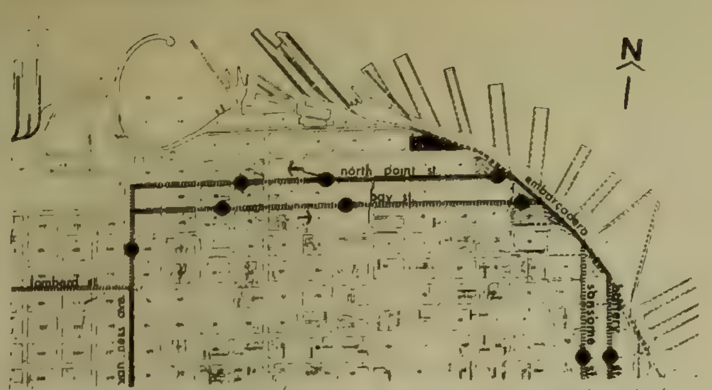
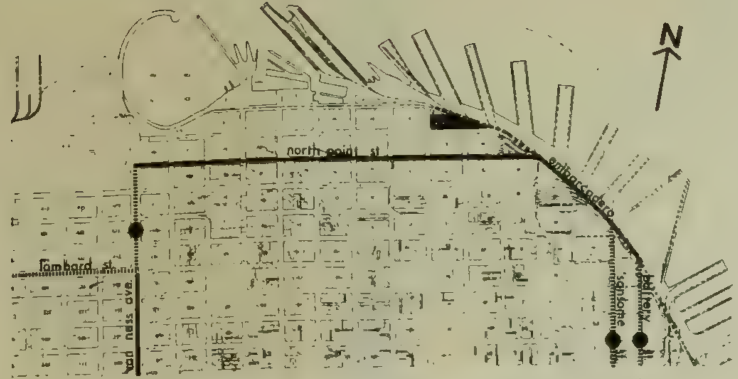
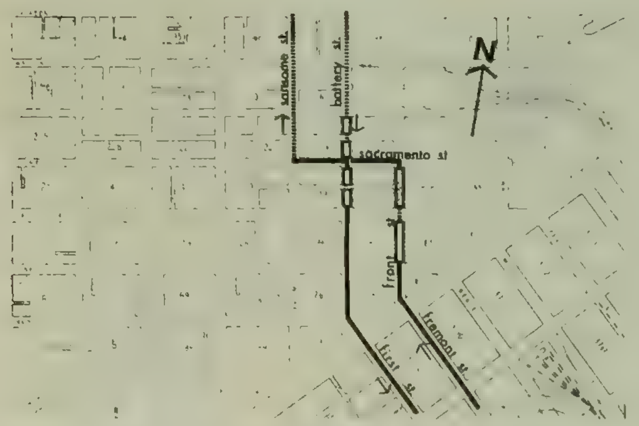


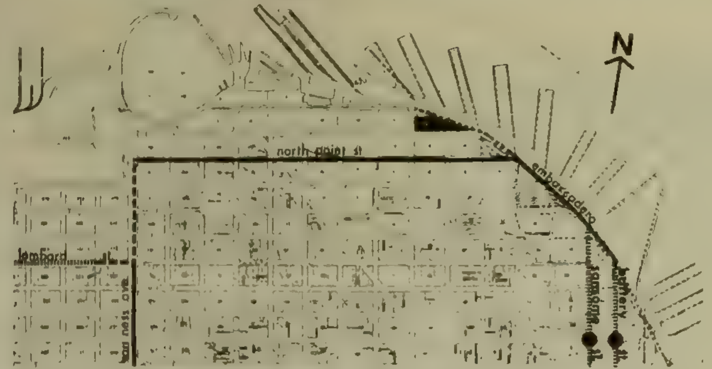
NORTH POINT/BAY STREETS ONE-WAY COUPLE WITH RESERVED BUS LANES



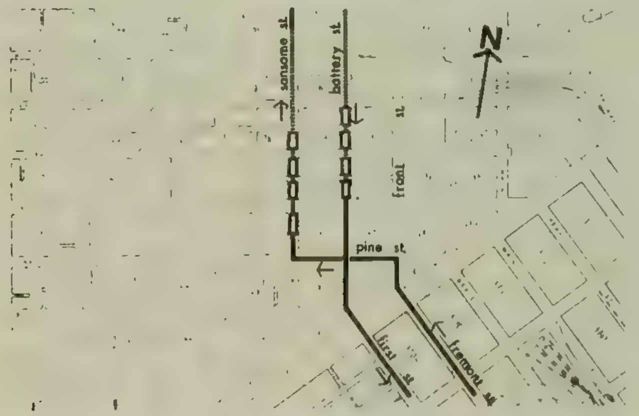
RESERVED REVERSIBLE BUS LANE ON NORTH POINT STREET



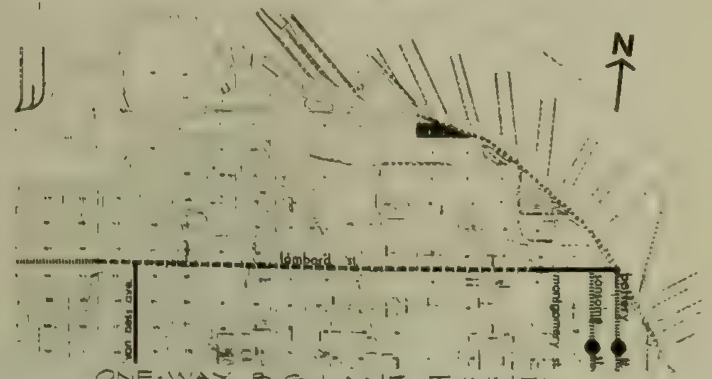
FRONT/BATTERY STREETS FINANCIAL DISTRICT LOADING ZONES



LOMBARD/VAN NESS UNDERPASS WITH RESERVED REVERSIBLE BUS LANE ON NORTH POINT



BATTERY/SANSOME STREETS FINANCIAL DISTRICT LOADING ZONES



ONE-WAY BUS LANE TUNNEL VAN NESS AVE TO MONTGOMERY ST.

LEGEND

- ━━━ BUS ROUTE IN MIXED TRAFFIC
- - - - - ONE-WAY BUS LANE TUNNEL
- ········ RESERVED BUS LANE
- ━━━ RESERVED REVERSIBLE BUS LANE
- ━▭┈ F.D. BUS LOADING ZONE
- ━●━ BUS STOP

FIGURE V 2

VAN NESS - BATTERY ALTERNATIVES AND FINANCIAL DISTRICT LOADING ZONE ALTERNATIVES

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-- North Point and Bay Streets

  - a reversible bus lane in the center of North Point Street
  - a reserve bus lane on North Point/Bay Streets one-waycouple

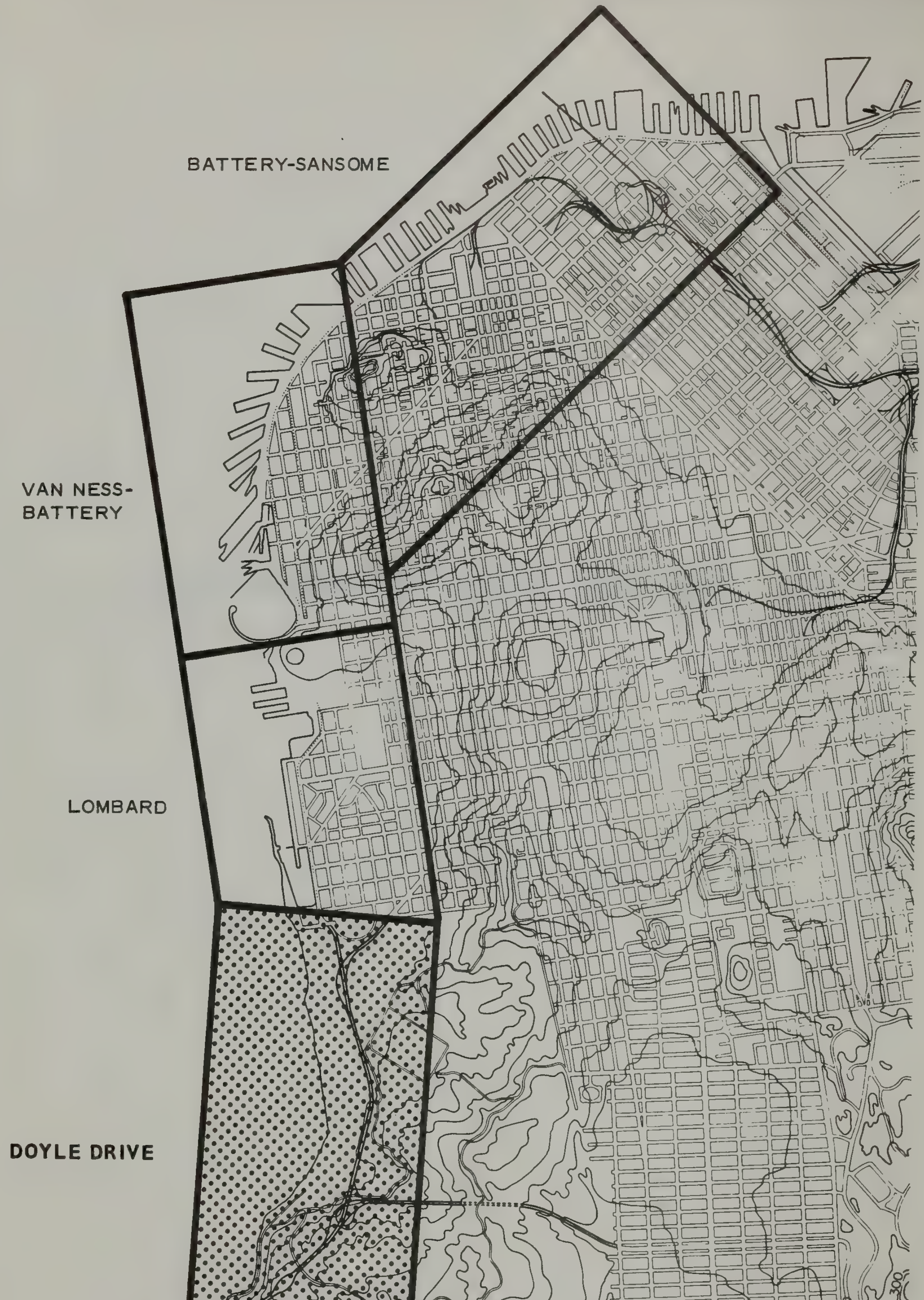
-- The Embarcadero - various options for a bus lane depending on the option on North Point and Bay Streets and the actions taken concerning Port development and improvement of The Embarcadero roadway.

-- The Lombard Tunnel - a tunnel under Lombard Street from Van Ness Avenue to about Kearny Street which by-passes all the surface streets in the segment.

- FINANCIAL DISTRICT SEGMENT - This segment goes from The Embarcadero to the Transbay Terminal via the Battery/Sansome Street one-way couple. This segment includes the main Financial District loading area. The options for this segment include:

-- a reserve bus lane
-- bus shelters at two alternative loading areas

DOYLE DRIVE SEGMENT


BATTERY-SANSOME
VAN NESS-
BATTERY
LOMBARD
DOYLE DRIVE
300

1. DOYLE DRIVE SEGMENT

The Doyle Drive segment consists of the 1.8 miles of elevated roadway from the Bridge Toll Plaza to Richardson Avenue. The roadway consists of six lanes, two of which are reversible, so that four lanes are in the peak direction during the peak periods. Yellow rubber traffic pylons are used to divide the traffic directions and control merges. The traffic during the peak periods, although at Level D, moves fairly smoothly at approximately 35 to 40 mph. Buses currently take about 3.1 minutes to travel the length of Doyle Drive.

The major problem with Doyle Drive is the safety aspects of the narrow lanes with relatively tight curves and blind merges. Due to these concerns, the California Department of Transportation is planning to improve Doyle Drive. However, political concerns about increased auto capacity and environmental concerns about adverse impacts to The Presidio have kept the project from final approval.

The following provisions are desirable for future bus operations on Doyle Drive and should be considered in any design improvements:

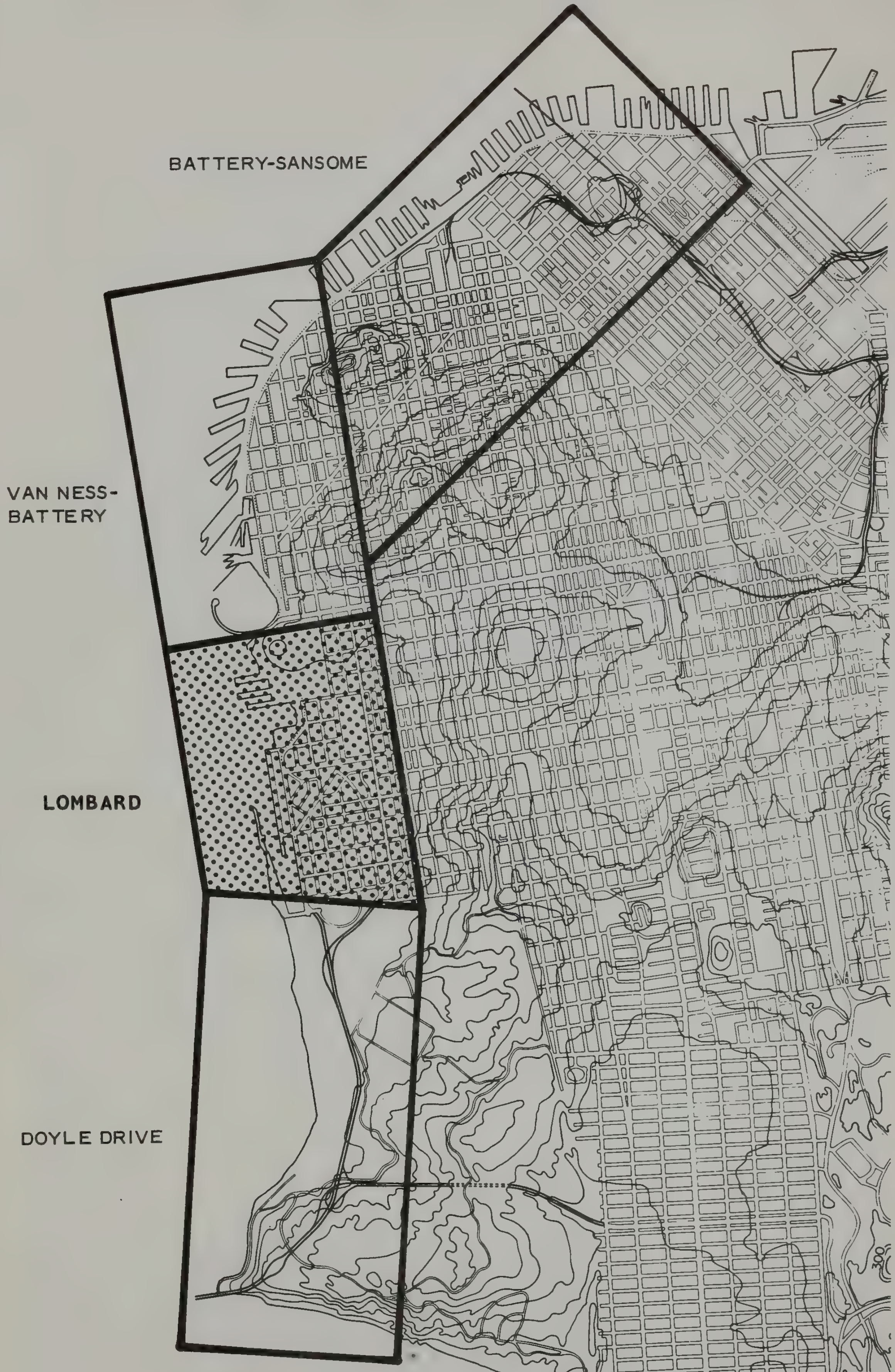
- There should be at least one reversible bus lane in the center of the roadway. However, two lanes would be required for convertibility to fixed guideway.
- The bus lane should continue through the ramps to the center lanes on Richardson Avenue.
- Merging auto traffic should not have to cross or merge with the bus lane.
- A bus stop should be in the center lanes at the Toll Plaza. This stop should have an enclosed waiting room and be accessed via an enclosed walkway.

If these conditions are designed into the Doyle Drive roadway improvements, present bus service will be maintained despite auto congestion. Depending on the design of the roadway and bus lane, bus travel times could be improved by up to one minute.

The center lane station at the Toll Plaza would improve travel time for those buses which presently must merge to the right to stop at the bus stop. In addition, the passengers using this stop would have more frequent service in the evening since all buses would be able to conveniently make the stop. The center bus stop would also be able to feed into a future reserve bus lane on the bridge.

LOMBARD SEGMENT

- Reserved Bus Lanes
- Contraflow Bus Lanes


BATTERY-SANSOME
VAN NESS-
BATTERY
LOMBARD
DOYLE DRIVE
300

2. LOMBARD SEGMENT

a. Existing Conditions

The Lombard segment, including Richardson Avenue and Lombard Street to Van Ness Avenue, is one of the most congested segments in the Golden Gate bus system. Currently, both the Financial District and Civic Center buses are operating in mixed traffic on Lombard Street, which has three 10-foot lanes in each direction separated by a 4-foot concrete median plus an 8-foot parking lane on each side. Bus stops are at Baker Street and Fillmore Street. Lombard Street, which is part of US Highway 101, carries approximately half of the peak period traffic which crosses the Golden Gate Bridge in addition to intra-San Francisco traffic from the northern waterfront area to northwestern part of San Francisco.

During the evening peak hour, 2,500 vehicles travel westerly through this segment on Lombard Street. At this volume, the street is operating at Service Level D. The average travel time through the 1.3 mile segment is 6.8 minutes which includes several stops at traffic lights. There are fourteen traffic lights in the segment which are set for 27 mph during the peak periods. However, the average peak period traffic flow is approximately 15 mph, and is unstable with fluctuations in volumes causing temporary restrictions and further reduced speeds.

An approximate 3% growth in traffic will cause Lombard Street to reach Service Level E. This level will likely be reached within the next several years, causing traffic flow to be more unstable with momentary stoppages. Average flow will be reduced to approximately 10 mph and travel time will increase by 3 minutes to 9.8 minutes.

b. Proposed Improvements

Two possible surface solutions to improving bus flow through the Lombard segment exist. One alternative, shown in Figure V-3 which follows, is to reserve the right-hand traffic lane for buses. The other alternative (see Figures V-4 and V-5), uses a lane in the nonpeak direction for buses which flow counter to the traffic on that side.

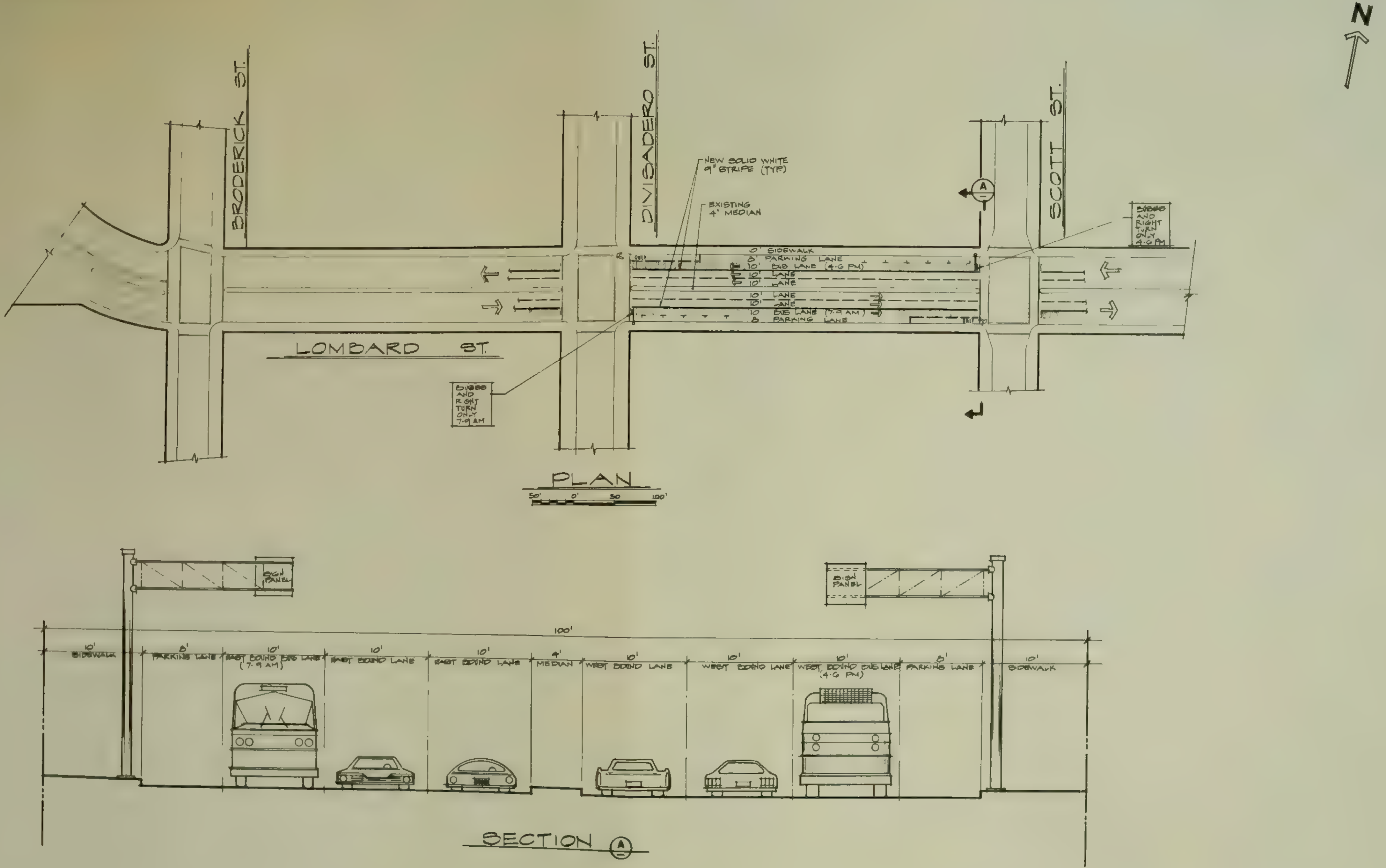


FIGURE V-3

LOMBARD STREET RESERVED LANES

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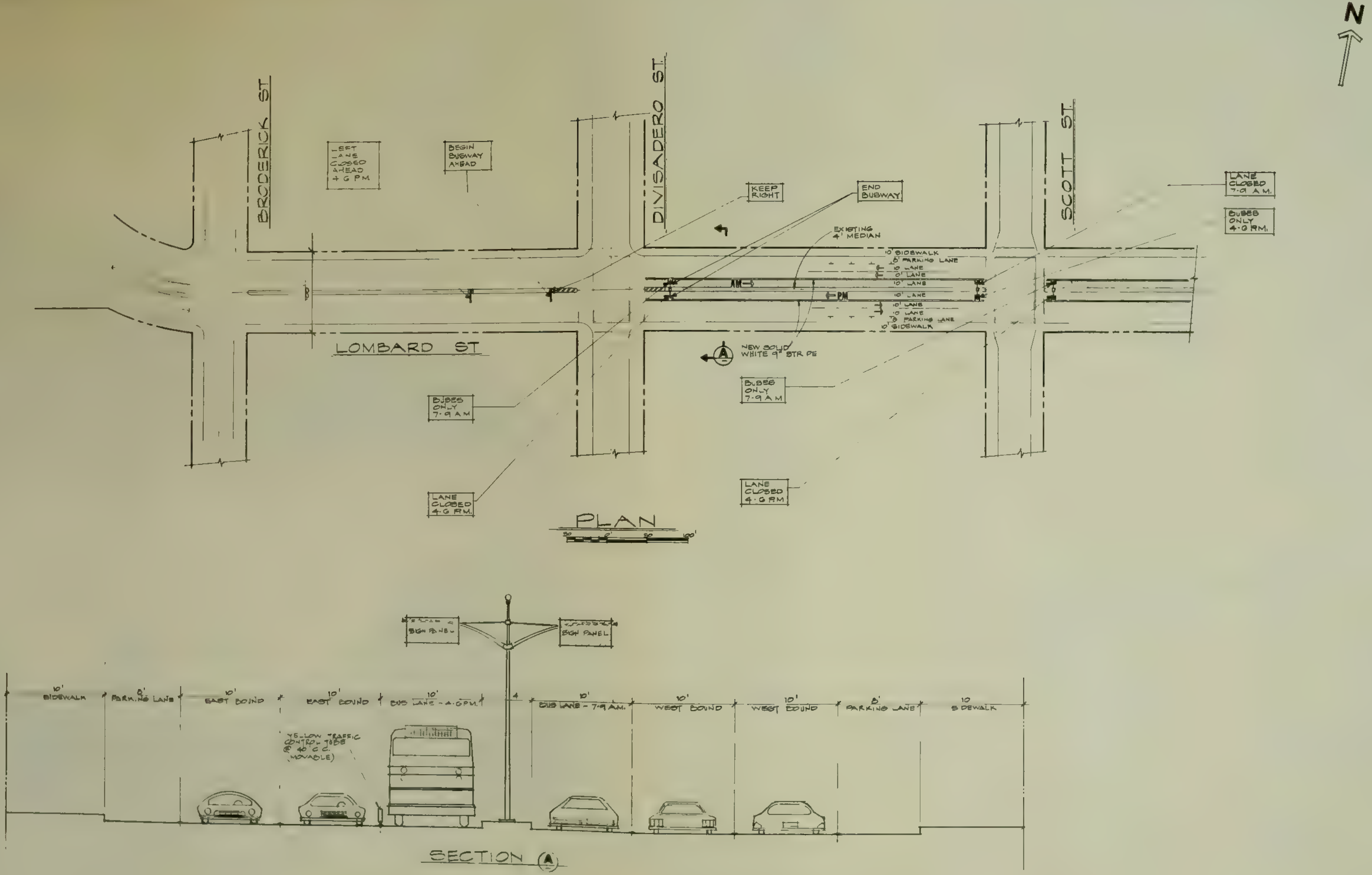
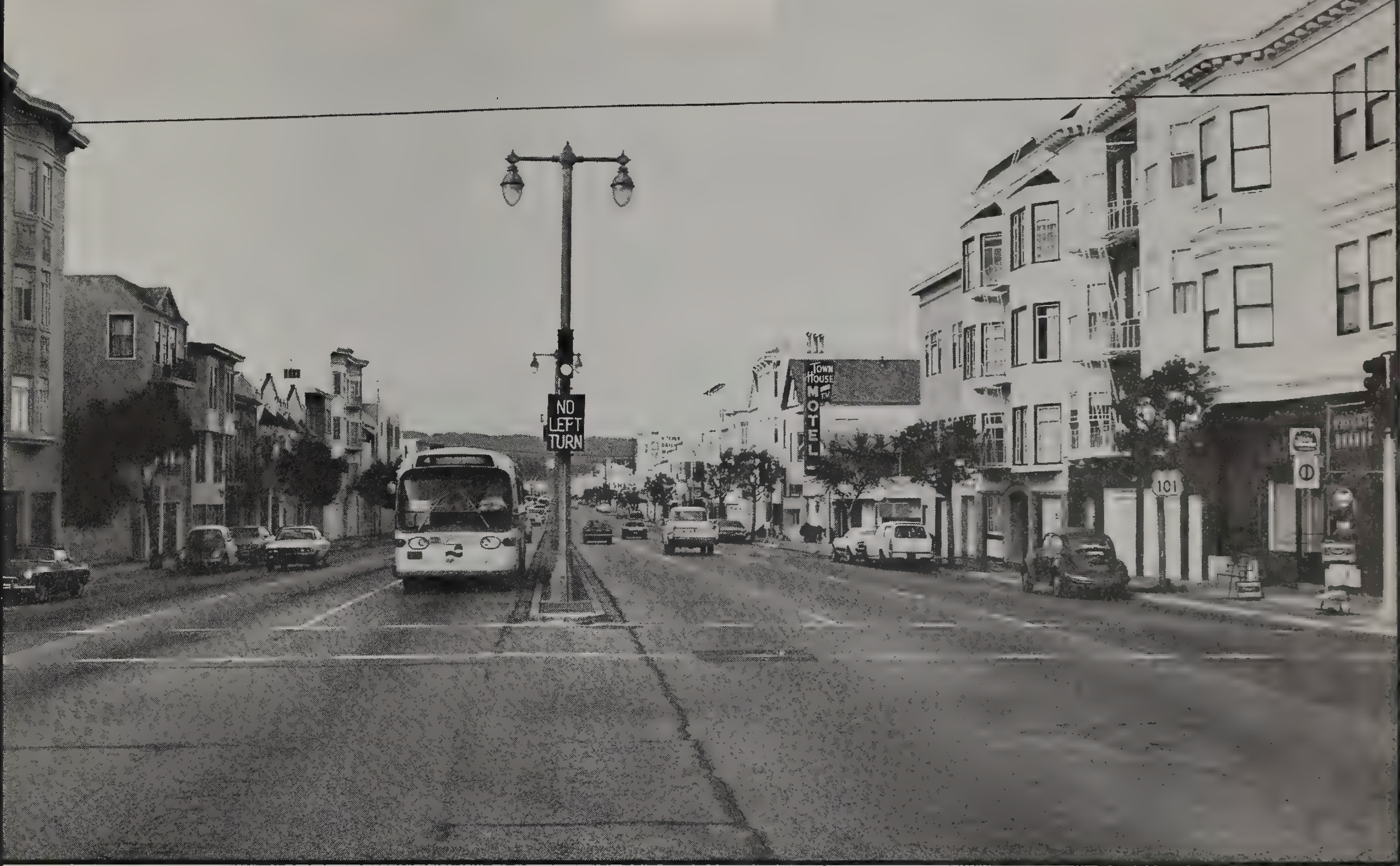


FIGURE V 4

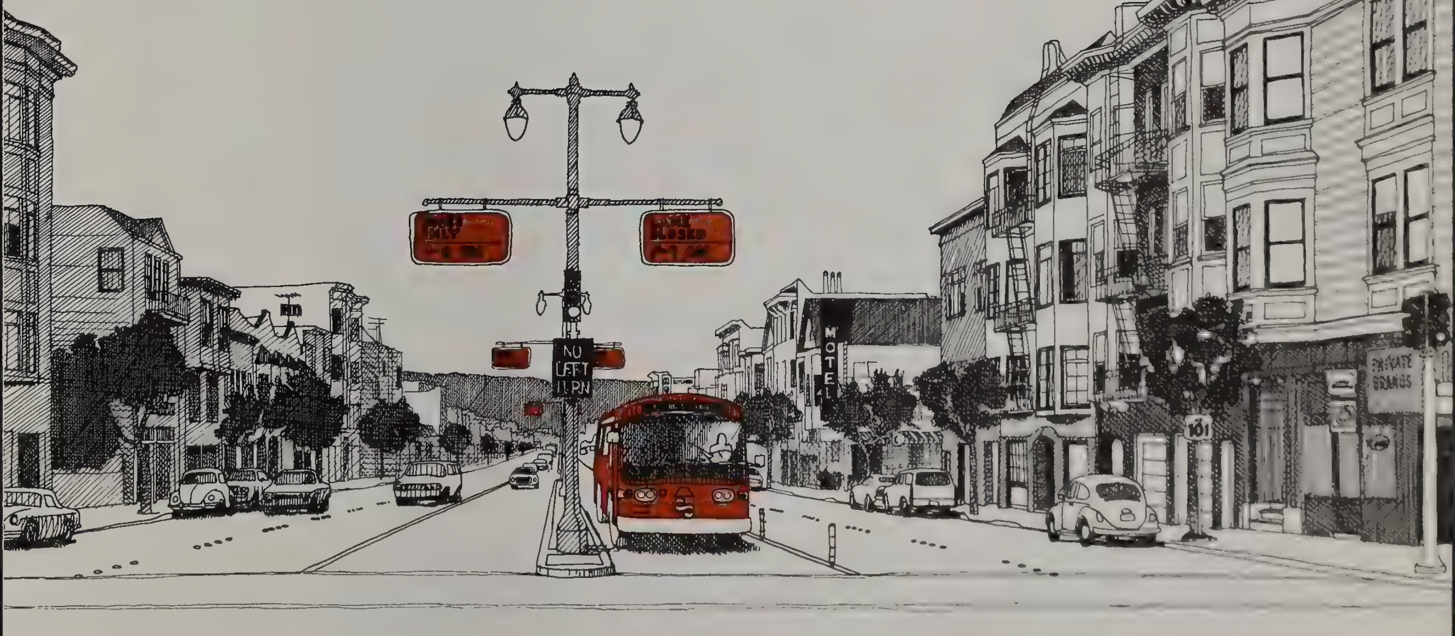
LOMBARD STREET CONTRAFLOW LANES

KAISER ENGINEERS

EXISTING



PROPOSED



LOMBARD STREET CONTRA-FLOW LANES

FIGURE V - 5

1) Reserve Bus Lane

The right-hand reserve bus lane was selected over the left lane in order to avoid reduced service on the Civic Center bus route. The Civic Center bus service must operate in the right-hand lane in order to maintain the bus stops on Lombard Street at Fillmore and at Baker Streets. The increased congestion to auto traffic and the Civic Center buses which would result from eliminating the left-hand auto traffic lane would increase travel time by approximately 5 minutes for the Golden Gate bus patrons who will be using the Civic Center service, a total of 34%.

Both the Financial District and Civic Center buses would operate in the right-hand reserve bus lane which would result in approximately a 3-minute travel time savings through the segment in 1975. However, the bus lane would be subject to interference from autos which cross through the bus lane to make right-hand turns, to park at the curb, and to enter and exit the numerous driveways to gas stations, motels, etc. along Lombard. This would negate some of the potential bus time savings.

Parking would be eliminated in the final 80 feet on each block in order to provide a right-hand turn lane separate from the bus lane.

A serious problem exists with the right-hand bus lane at the intersection with Van Ness Avenue. The Financial District buses must turn left in the morning onto Van Ness Avenue crossing the heavy traffic flow which is turning right onto Van Ness Avenue. In order to provide for the bus movements, the existing traffic light cycle must be altered to allow a separate phase for the buses. With the current 90 second cycle, approximately 25 seconds would have to be devoted to the bus left-hand turn movement in 1975. This would go up to 30 seconds by 1990. The amount of time within this light cycle which could be devoted for buses will control the capacity of this reserved bus lane.

The capital cost estimate for signing and striping for the right-hand reserve bus lane would be $153,000. There would be virtually no operating cost associated with the fixed facilities.

2) Contraflow Bus Lane

The other alternative, a reserve bus lane in the contraflow direction, would serve only the Financial District buses (see Figures V-4 and V-5). However, there would not be a negative impact on the Civic Center buses since the remaining traffic would continue to have three lanes. Details of the bus cross-over to the contraflow lane would need to be coordinated with the Doyle Drive improvements and the San Francisco Department of Public Works. In general terms the buses using the contraflow bus lane on Lombard Street would operate in a left-hand reserve bus lane on Richardson Avenue and cross over to the opposite side of the median prior to Divisadero Street. Should future changes eliminate the left turn lane on Lombard at Broderick Street, a more efficient cross-over would be designed at that intersection.

Overhead signs, yellow rubber traffic pylons, and pavement striping would be used to separate the auto traffic and buses. There would be no interference from any auto movement the entire length of the segment; thus the buses should always be able to travel at the speed set by the traffic lights. The contraflow lane would save about 3 minutes travel time through the segment in 1975.

The Lombard Street and Van Ness intersection will not create the same problem for the contraflow lane that the right-hand lane alternative has since the buses can make the left-hand turn during the same signal phase the majority of the auto traffic is turning right onto Van Ness. The current signal cycle with 51 seconds green for Lombard would be sufficient for projected bus volumes well past 1990. The evening direction would have some limitations which are discussed in the Van Ness Avenue segment.

The capital cost of signs, pylons, and striping would be $48,000. There would be an operating cost for placing and picking up the rubber traffic pylons twice a day.

The initial 3-minute time savings for a reserve bus lane would generate about a 2-1/2% increase in bus patronage -- about 160 new riders. The relative time savings over mixed traffic conditions would increase to 6 minutes by 1990, which would attract about 4-1/2% more riders.

c. Existing Environment

The route segment is located on a major traffic arterial between the Marina and Cow Hollow residential neighborhoods. Predominant land uses for the area surrounding the route are mixed commercial and residential with the latter respresenting 56% of the total acreage. Building heights and urban form may be characterized as low rise, wood frame attached structures.

Major regional travel destinations in the segment are the Palace of Fine Arts and Letterman Hospital in The Presidio. Both are located in the western portion of the route segment and are served by a bus stop at Baker Street. The Palace of Fine Arts is a regional recreation facility which will generate off-peak hour transit service. Letterman Hospital is a major travel destination in the segment and is expected to generate both peak and off-peak transit trips.

Lombard Street is the boundary between the Marina and Cow Hollow residential neighborhoods. The segment lies within three census tracts which have a total population of 15, 382. Residents have a median family income of $13, 690, an amount $3, 187 above the City average. Approximately 5-1/2% of the families are below the poverty level compared to a 10% average for the City.

The area appears to be stable, the percentage of owner-occupied units is lower than the City average, 18% compared to 31%, and almost half the area's residents have lived in the same units for five or more years.

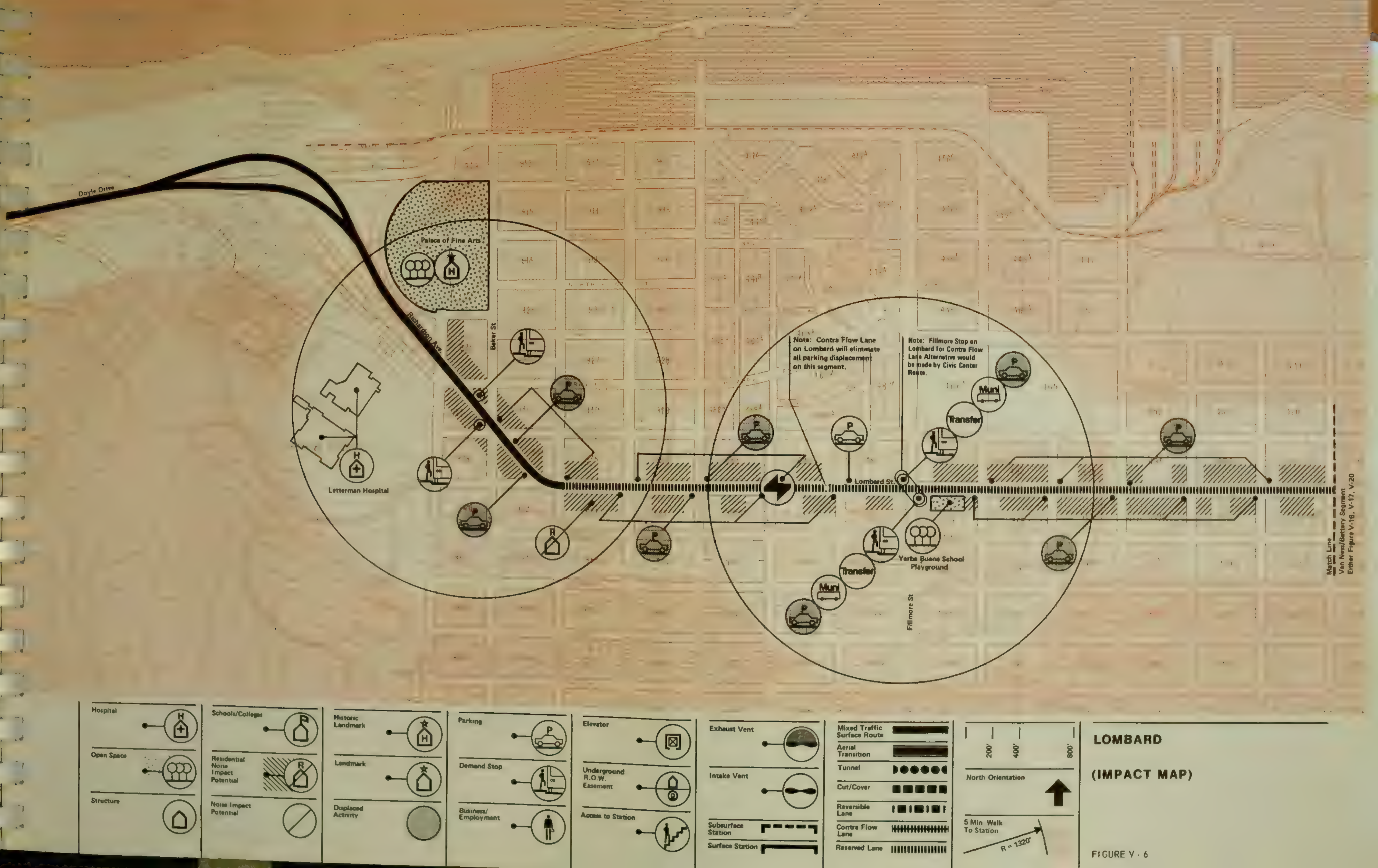
Employment and population growth forecasts for the years 1970 and 1990 indicate very little change, less than 2% growth for both categories.

d. Impacts

The impacts along Lombard Street are graphically shown in Figure V-6.

1) Disruption

With the right-hand reserve bus lane, a major disruption will likely occur to the auto-oriented businesses along Lombard Street. During the peak periods, 72 parking places for the



LOMBARD

(IMPACT MAP)

FIGURE V · 6

whole segment will be displaced to provide right-hand turn lanes separate from the bus lane. In addition, the bus lane would create a traffic barrier effect for the remainder of the curbside parking and disrupt access and egress from off-street parking.

This displaced and restricted parking access created by the right-hand reserved bus lane on Lombard Street may adversely affect 91 auto-oriented businesses on Lombard Street, since many of these firms rely on the availability of easy parking and vehicular access for their business activity. An explicit economic relationship exists between gross leasable retail floor area (GLA) and availability of parking, generally considered to be one parking space per 1,000 square feet of GLA[1]. Once parking has been reduced beyond this index, retail sales may be adversely affected. Equivalent annual retail sales of 5.9 million could be lost because of reserved right lane on Lombard. For further details see Appendix VIII, Economics.

The contraflow lane will not impact the parking of the businesses along Lombard Street.

2) Visual and Physical

For the most part, visual disruption in this segment is limited to signs erected for reserved or contraflow lanes (Figures V-3, V-4 and V-5). Signs will add somewhat to the visual clutter on Lombard Street. The signs required for the right-hand reserve lane have more massive structural supports than those required in the median for the contraflow lane.

Since the neighborhoods on either side of the route have limited or no functional activity linkage, it is not anticipated that intrusion of bus operations on Lombard Street will add visual or psychological barriers.

3) Noise

The bus lanes described above would lead to a slight improvement on the noise emitted by the Golden Gate buses along Lombard Street. The bus lanes would enable the buses to

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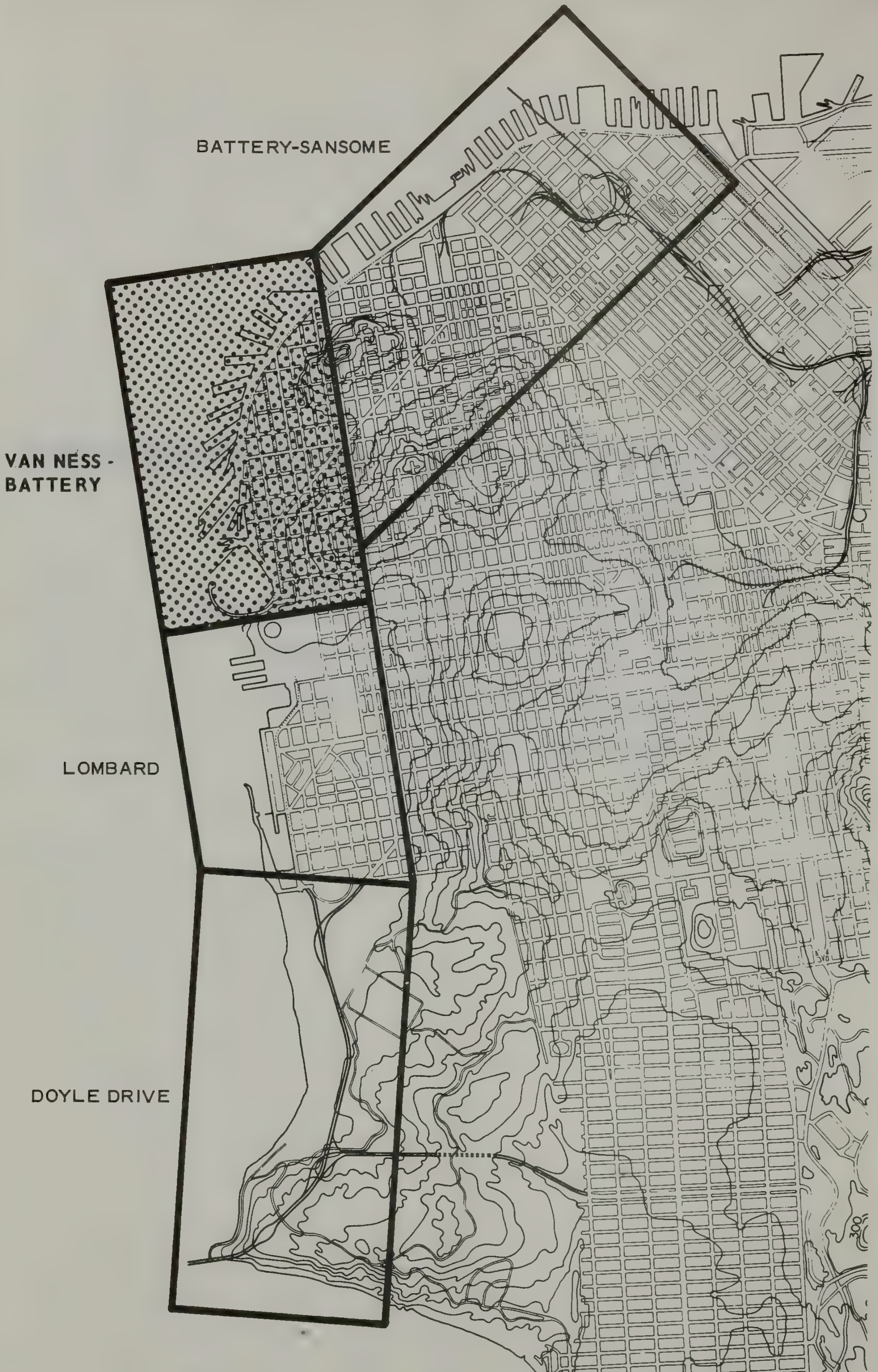
[1] Urban Land Institute, Community Builders Handbook, 1968, page 268.

drive at more constant speeds and reduce the number of stops due to traffic and signals and, thereby, reduce the relatively high bus noise during acceleration. The contra-flow lane would have a slightly higher noise benefit over the right-hand reserve lane since the buses would be farther from the buildings and have less interference from auto traffic.

VAN NESS - BATTERY SEGMENT

- Van Ness Reserved Lanes
- Van Ness Underpass
- North Point Reversible
- North Point/Bay Couple
- Embarcadero Reversible
- Lombard Tunnel


BATTERY-SANSOME
VAN NESS - BATTERY
LOMBARD
DOYLE DRIVE

3. VAN NESS TO BATTERY SEGMENT

The segment of the Golden Gate bus system between Van Ness Avenue and Battery Street contains the areas most restricted for handling increased buses, as well as the areas most likely to be negatively impacted by bus operations.

Currently the Financial District buses, which carry approximately 72% of the Golden Gate transbay bus passengers, operate in mixed traffic through this segment via Van Ness Avenue from Lombard Street to North Point Street, on North Point Street to Columbus Avenue, on Columbus Avenue to Bay Street, on Bay Street to the Embarcadero, and on the Embarcadero to the Battery/Sansome Streets one-way couple. Bus stops in the segment are on Van Ness Avenue at Chestnut, on North Point Street at Hyde Street, and on Bay Street at Taylor and Kearny Streets.

There are several combinations of bus service improvements that can be made to the various portions of this segment. The Van Ness section has two possible improvements, one of which involves a major capital investment. The North Point/Bay Street section also has two possible improvements depending on the city of San Francisco's decision concerning auto traffic on these streets. Bus preferential treatment is also possible on the Embarcadero.

The limitations and impacts with the surface street improvements are serious enough in this segment that a major capital investment in a one-way tunnel bypassing this whole segment with surface street improvement for the remainder of the system is also looked at in detail.

a. Van Ness Avenue

The one-quarter mile section of Van Ness Avenue between Lombard Street and North Point Street contains the two most restrictive intersections on the Golden Gate bus route within San Francisco. The only bus stop within this section is at Chestnut Street.

1) Existing Conditions

Currently, the traffic operating conditions on this section are at Service Level C and relatively uncongested. It takes an average of only 2 minutes to travel this section of Van Ness Avenue, over half of which is time waiting at stoplights. The buses must cross the high volume of traffic on Bay Street and the evening peak traffic flow coming south on Van Ness Avenue and turning onto Lombard Street, which causes the high waiting time.

The existing traffic signal at Bay Street is on a 100-second cycle in the morning with only 18 seconds of green light for Van Ness. With this setting the maximum rate of buses through this intersection will be approximately 145 buses per hour. The patronage forecast indicates that this rate will be reached about 1985.

During the evening period, the signal at Bay Street is on a 75-second cycle with 20-second green on Van Ness. This would allow a rate up to 190 buses per hour. However, in the evening the buses are also restricted at the Lombard Street intersection. The signal cycle allows the northbound traffic on Van Ness Avenue, which includes the buses, to go 30 seconds in the 92-second cycle. In addition, only the first 7 seconds are free of interference from the left-hand turning movement from southbound Van Ness Avenue traffic. Thus, this signal in combination with the Bay Street signal would limit bus capacity at a rate of approximately 160 buses per hour. This rate is expected to be exceeded between 1985 and 1990.

2) Proposed Improvements

a) Reserve Bus Lanes

The reserve bus lane would not significantly reduce current travel time for the buses. As traffic levels increase, buses will be stopped at intersections for more than one cycle. When this occurs reserve bus lanes on Van Ness

would help to minimize this occurrence and maximize the number of buses able to go through these intersections. A typical reserve bus lane in the right-hand lane is shown in Figure V-7. The capital cost estimate to implement this reserve bus lane is $49,000.

b) Bus Underpass

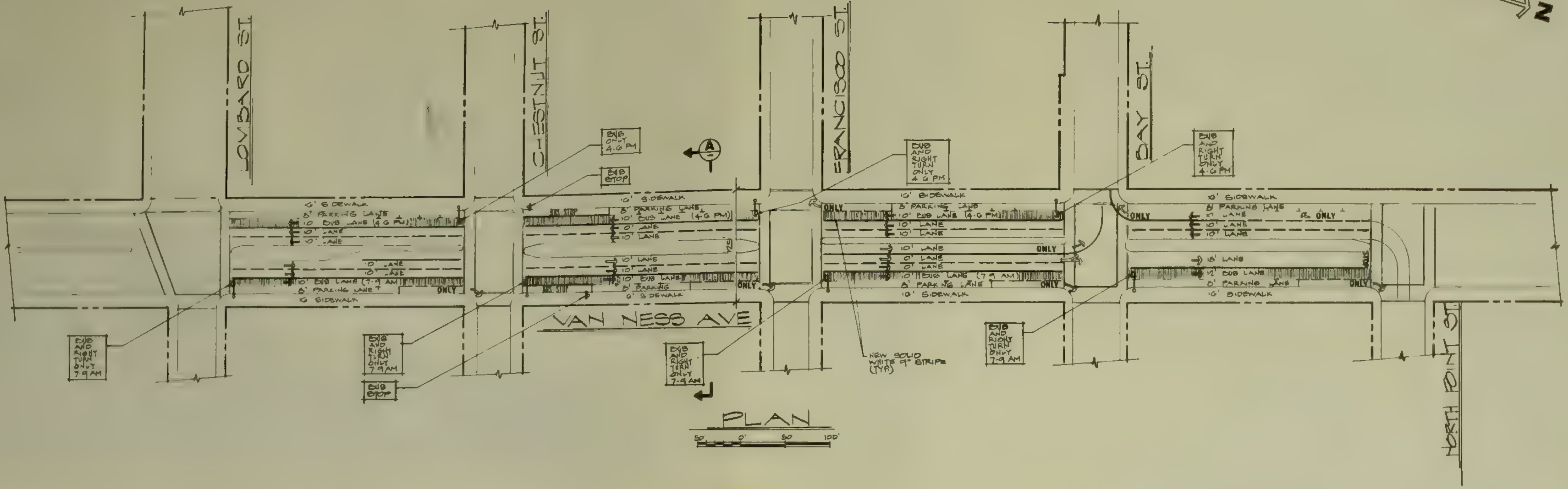
Another proposed solution to the limited capacity at these two intersections is to bypass them with a reversible one-way bus underpass from Lombard Street to North Point Street. A reversible one-lane bus underpass, shown in Figures V-8 to V-10 is estimated to cost $6.39 million.

The underpass would save about 1-1/2 minutes over existing travel time. This would generate about 1-1/4% increase in bus patronage or about 80 new riders in 1975. However, after 1985 when a bus could be stopped at a signal for more than one cycle, the relative time savings will be an additional 2 to 3 minutes.

The underpass is compatible only with the contraflow bus lane of Lombard Street and with bus service on North Point Street. The Bay and North Point one-way couple which is discussed in the next section would not be compatible with the underpass due to the need for access to Bay Street from the underpass.

3) Impacts

The major impact of these proposed improvements would occur during the construction of the Van Ness underpass. There would also be some parking displacements for both the reserve lane and underpass improvements. The impacts are shown graphically for the reserve bus lanes in Figure V-16 and for the bus underpass in Figure V-15.



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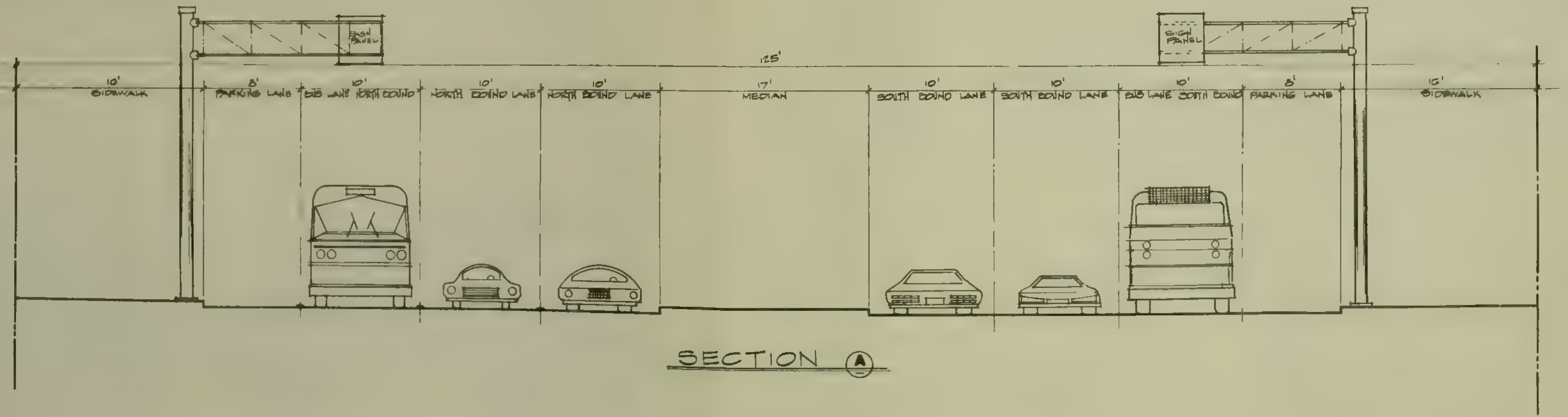

SECTION A

FIGURE V 7

VAN NESS AVENUE RESERVED LANES

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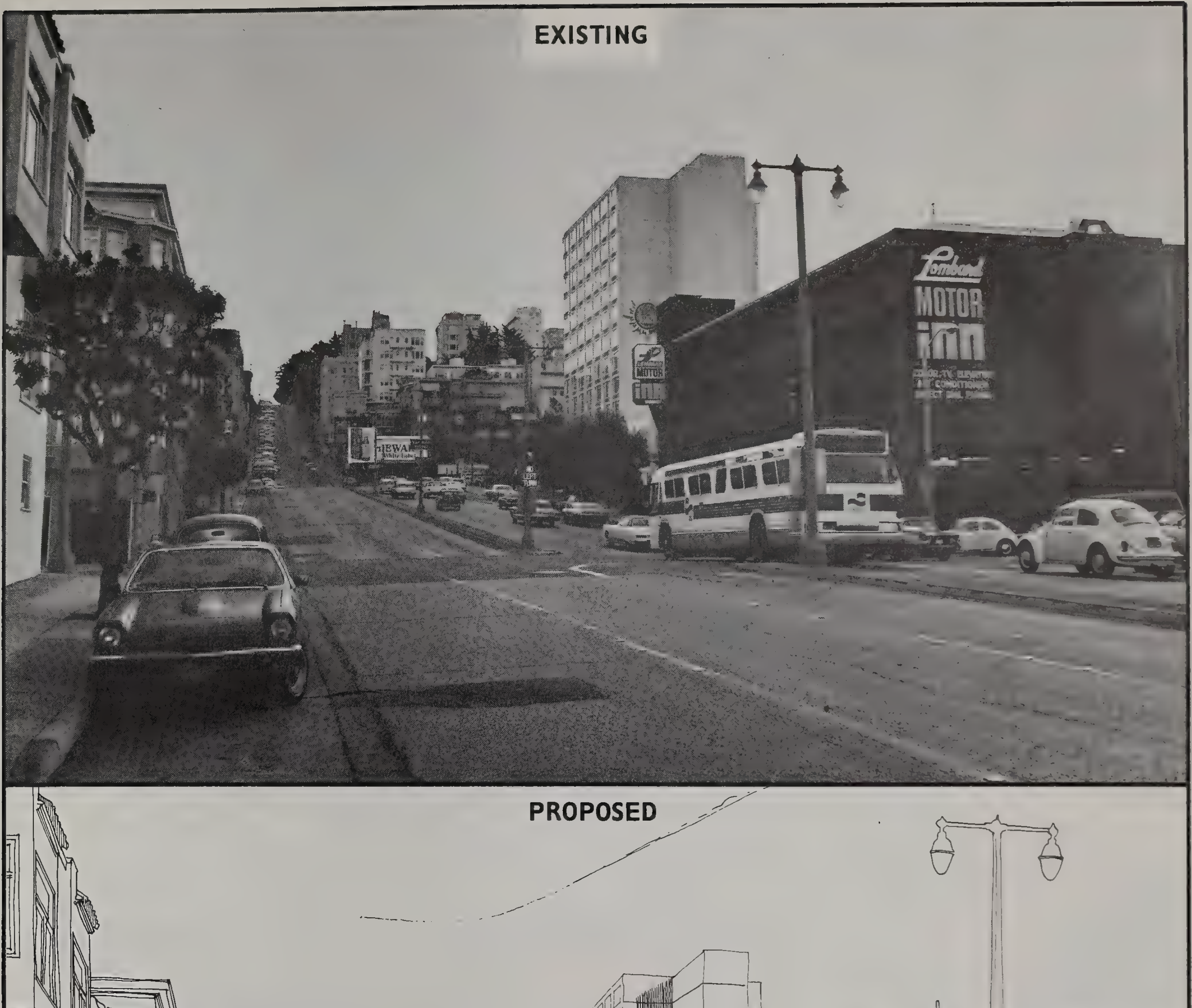


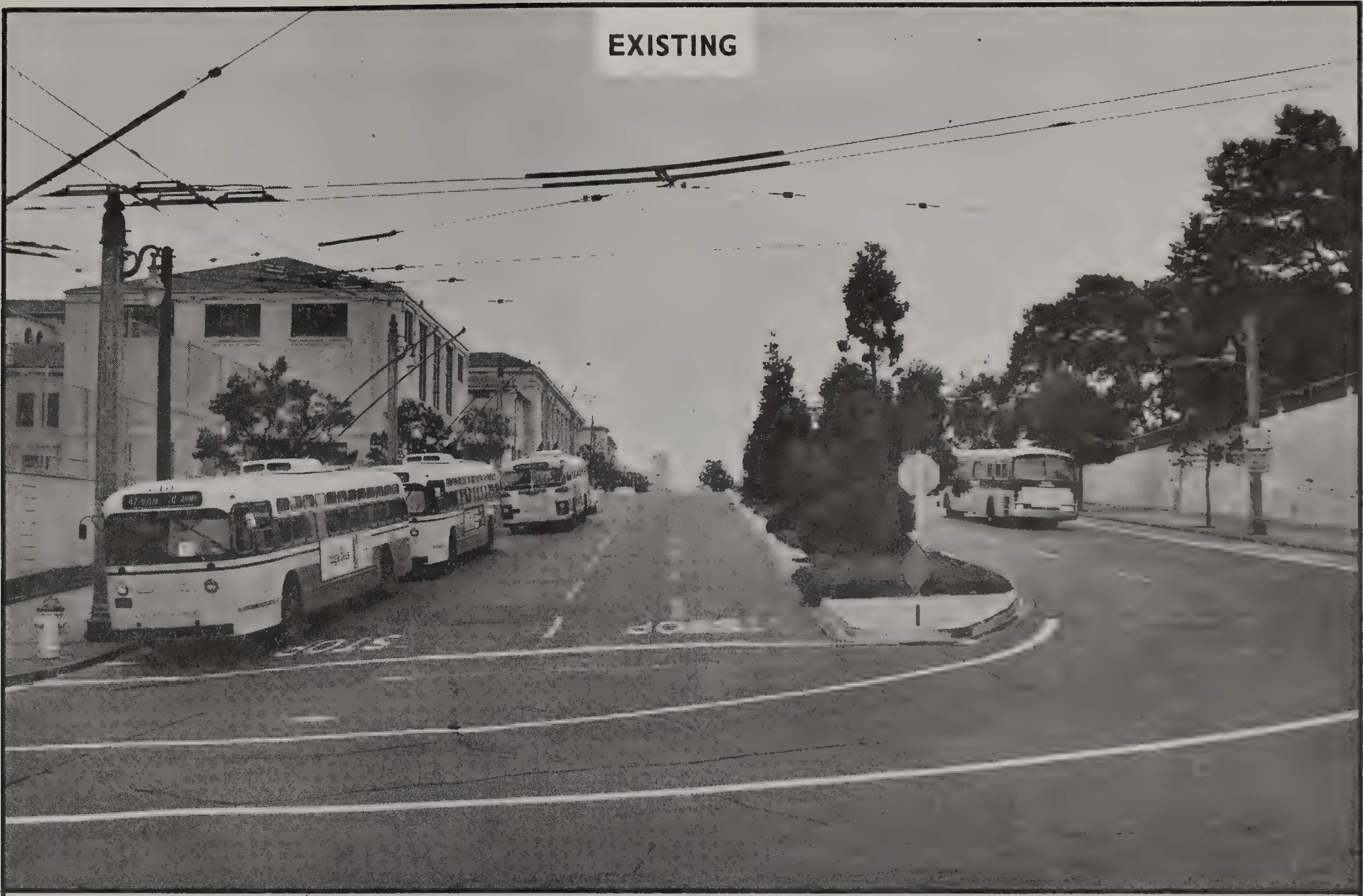
EXISTING

PROPOSED

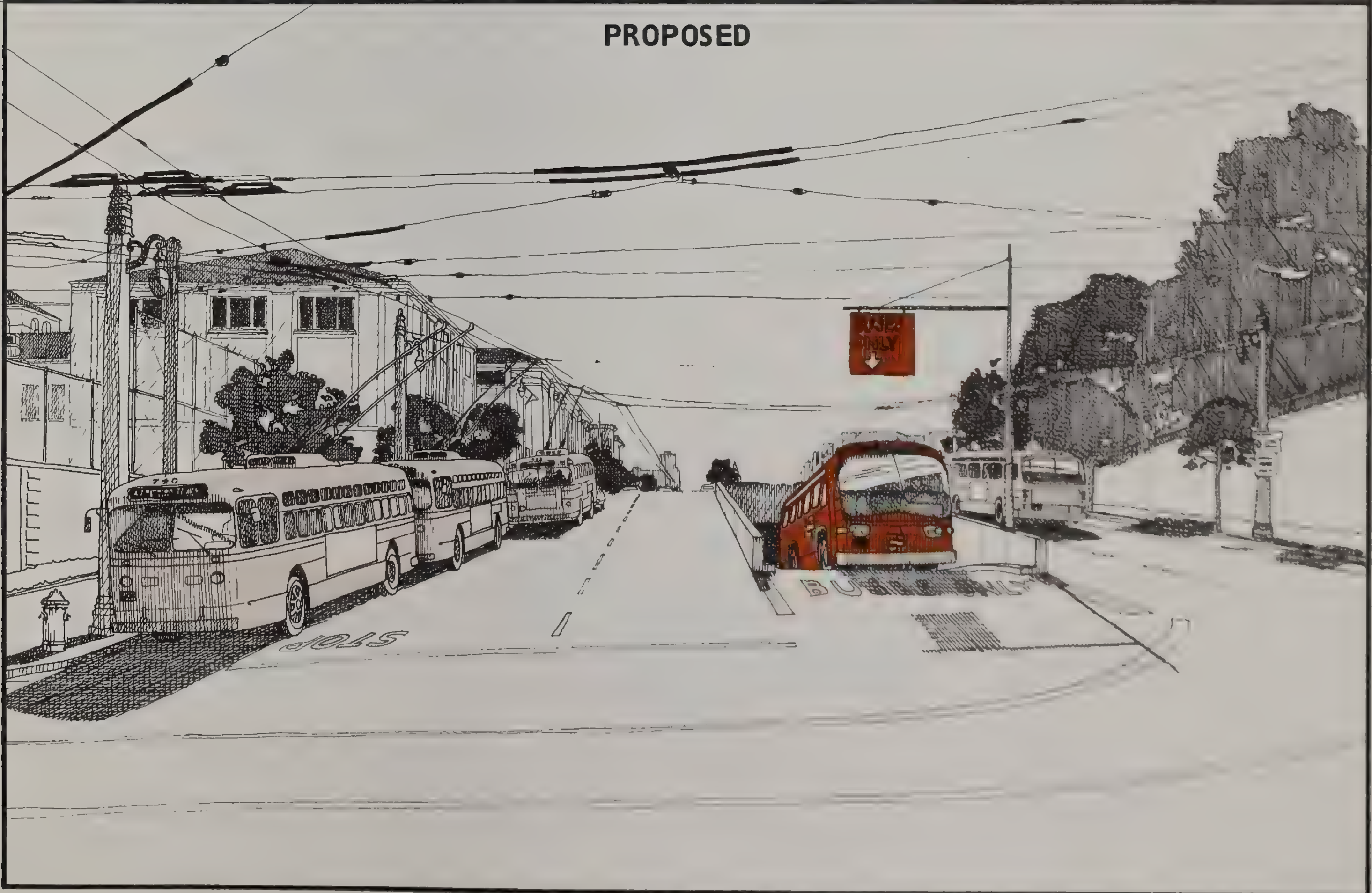
TUNNEL PORTAL AT VAN NESS AND LOMBARD

FIGURE V - 8

EXISTING



PROPOSED



TUNNEL PORTAL AT VAN NESS AND NORTH POINT

FIGURE V - 9

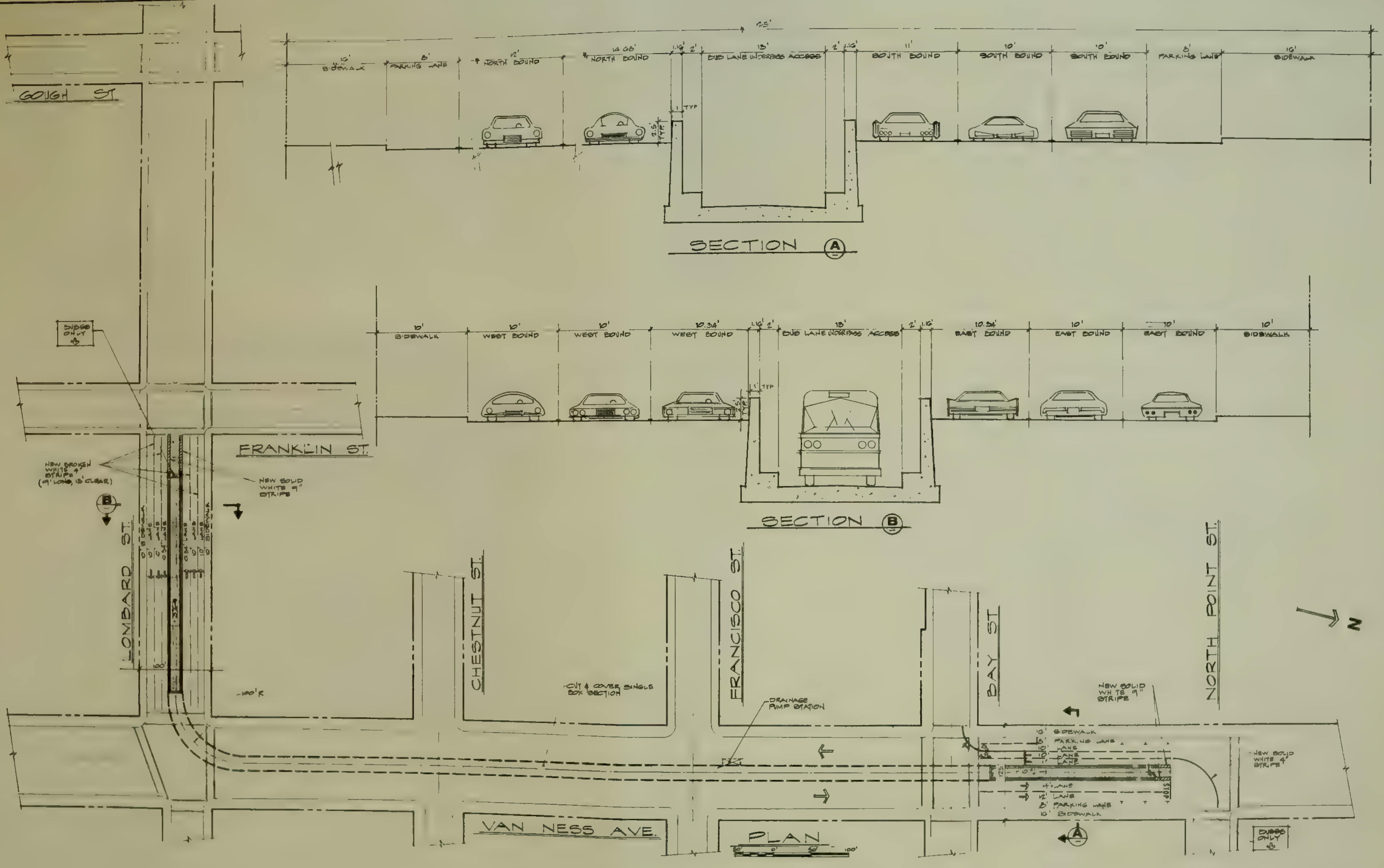


FIGURE V-10

LOMBARD/VAN NESS UNDERPASS

KAISER ENGINEERS

a) Construction Disruption

A major disruption will occur during the cut-and-cover construction of the underpass. A major traffic disruption will occur at the intersection of Van Ness Avenue and Lombard Street from the start of construction to the installation of the temporary decking. This will be a period of approximately two months. A similar disruption will occur to Bay Street traffic at Van Ness Avenue. The width of Van Ness Avenue and the relatively low traffic volumes between North Point Street and Lombard Street will enable Van Ness Avenue to function without serious disruption during the construction except at the Lombard Street intersection.

There also will be noise disruption to Galileo High School during this same initial construction period.

b) Displacements

The reserve lane will displace 13 parking spaces along Van Ness Avenue for right-hand turning lanes. To accommodate the underpass portal on Lombard Street, the parking lanes will be eliminated on Lombard Steeet between Franklin Street and Van Ness Avenue causing the displacement of approximately 15 parking spaces.

c) Noise Reduction

The underpass will have the beneficial impact of eliminating the noise associated with the peak period buses on Van Ness Avenue. The elimination of the noise in the afternoon will be the most significant since these buses are currently going up the grade between North Point and Bay Street and are frequently accelerating from stop signals. Both of these conditions are noisiest for the bus operations. This will be especially beneficial to the playground and high school next to the route.

d) Visual and Physical

The portal on Van Ness Avenue between Bay and North Point will cause the displacement of the landscaped parking median. The existing grade on Van Ness will help to minimize the visual impact of this portal. Architectural treatment of the portals is illustrated in Figures V-8 and V-9.

e) Accessibility

The underpass improvement would necessitate the elimination of the bus stop at Van Ness and Chestnut and consequently reduce accessibility offered by the existing and reserved lane treatment. The next closest stop would be provided on the Civic Center route at Van Ness and Union, four blocks to the north.

b. North Point and Bay Streets

1. Existing Conditions

There are three alternative routes for the buses to travel from Van Ness Avenue to the Embarcadero. Currently, the buses travel on North Point Street west of Columbus Avenue, and cross over to Bay Street via Columbus Avenue for the remainder of the distance to the Embarcadero. The current travel time for this 1-mile segment is 5.0 minutes. Traffic conditions for this route are relatively uncongested and are at Level C for most of the route. Average traffic flows are about 15 mph with the Bay Street section the most congested. The morning peak on the North Point Street section has only one lane and is therefore very sensitive to traffic conditions. The traffic signal where the buses must make a left-hand turn in the morning from Columbus Avenue to Bay Street is a potential limiting factor with the current route. The buses have only 21 seconds out of the 100-second cycle to make this turn. This limits bus capacity to a rate about 144 buses per hour, a rate that is expected to be reached by 1990.

Travel time on the existing route would increase to 6.8 minutes if traffic conditions reached Service Level E.

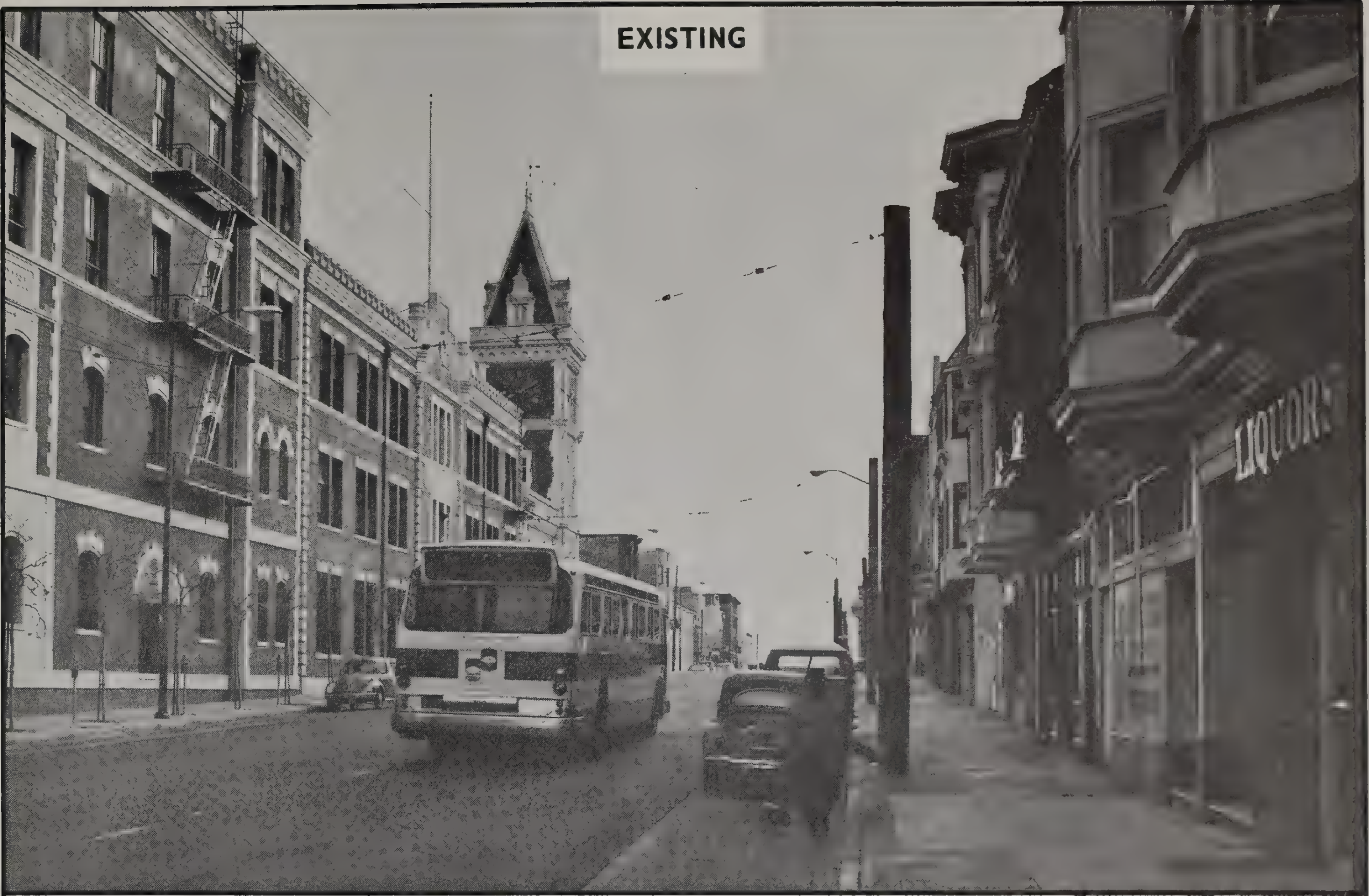
The two alternative routes through this segment both have the possibility of reserve bus lanes which would provide immediate travel time savings for the buses. One of these alternative routes would use North Point Street for the entire section, the other would combine Bay Street and North Point Street into a one-way couple. Both of these solutions would bypass the left-hand turn requirement at Bay Street and Columbus Avenue and decrease the travel time from the Embarcadero to Van Ness Avenue.

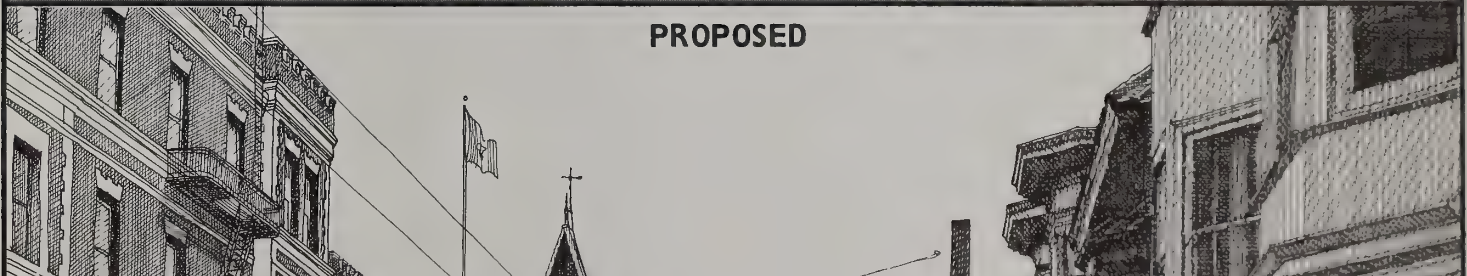
The Taylor Street Cable Car line terminates just south of Bay Street discharging pedestrians destined for Fisherman's Wharf. These pedestrians cross both Bay and North Point Streets in significant numbers which presents a safety hazard and pedestrian conflict with Golden Gate bus operations. Plans are being made to extend the Taylor Cable Car route to Beach Street which would reduce the pedestrian conflict with bus operations but introduce a new stop light on the bus route.

2. Proposed Improvements

a) North Point Reversible Bus Lane

North Point west of Columbus Avenue is currently a three-lane street with two lanes in the western direction. The proposed reserve bus lane, shown in Figures V-11 and V-12, would be reversible in the center lane. There are two options for the bus stops at Hyde Street and at Taylor Street: Either they would be eliminated, relying on MUNI service to feed the Golden Gate buses; or, they would be served by designated nonexpress Golden Gate buses which would not operate in the reserve bus lane.


EXISTING


PROPOSED

NORTH POINT STREET REVERSIBLE LANE

FIGURE V - 11

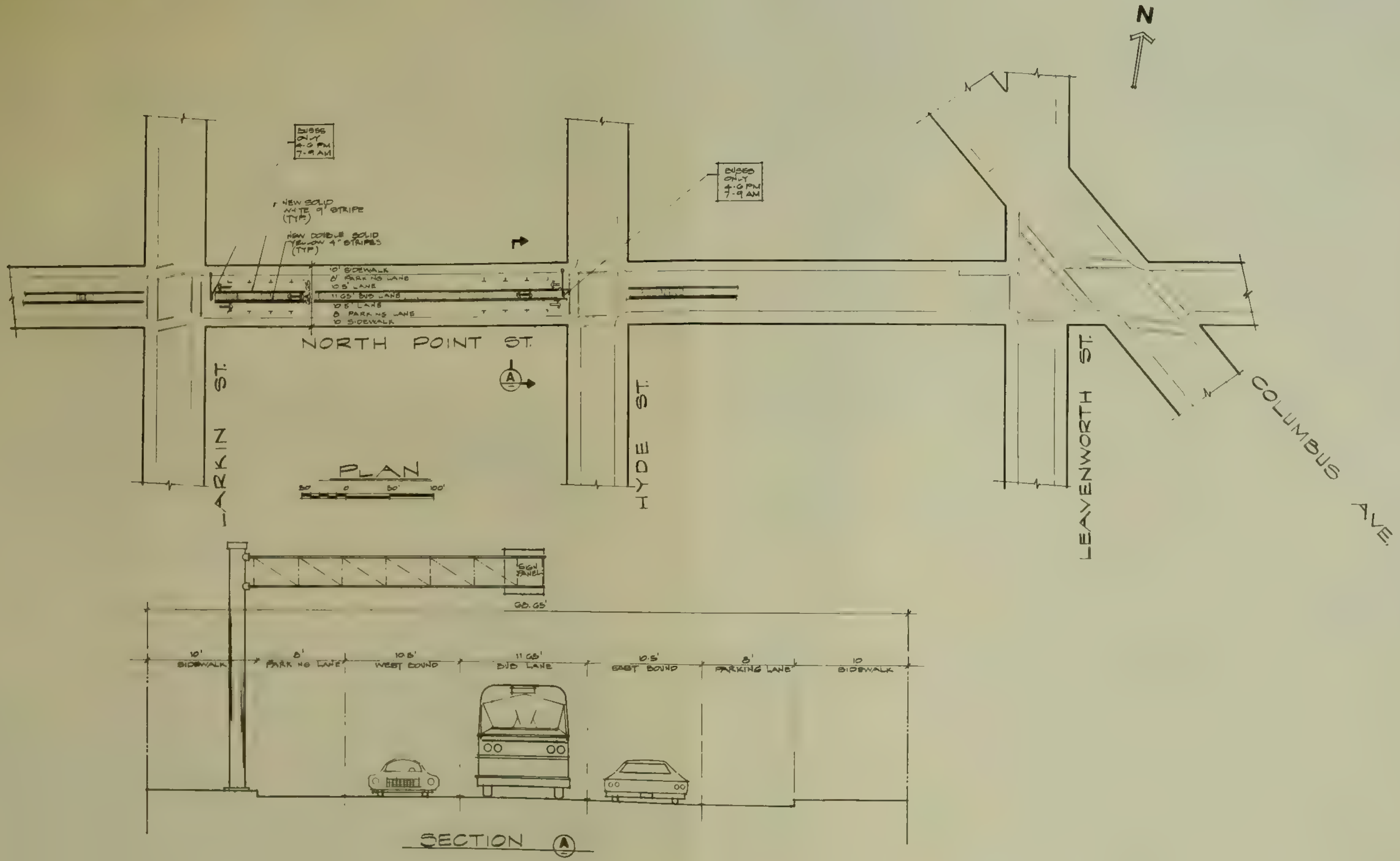


FIGURE V 12

NORTH POINT STREET REVERSIBLE LANE

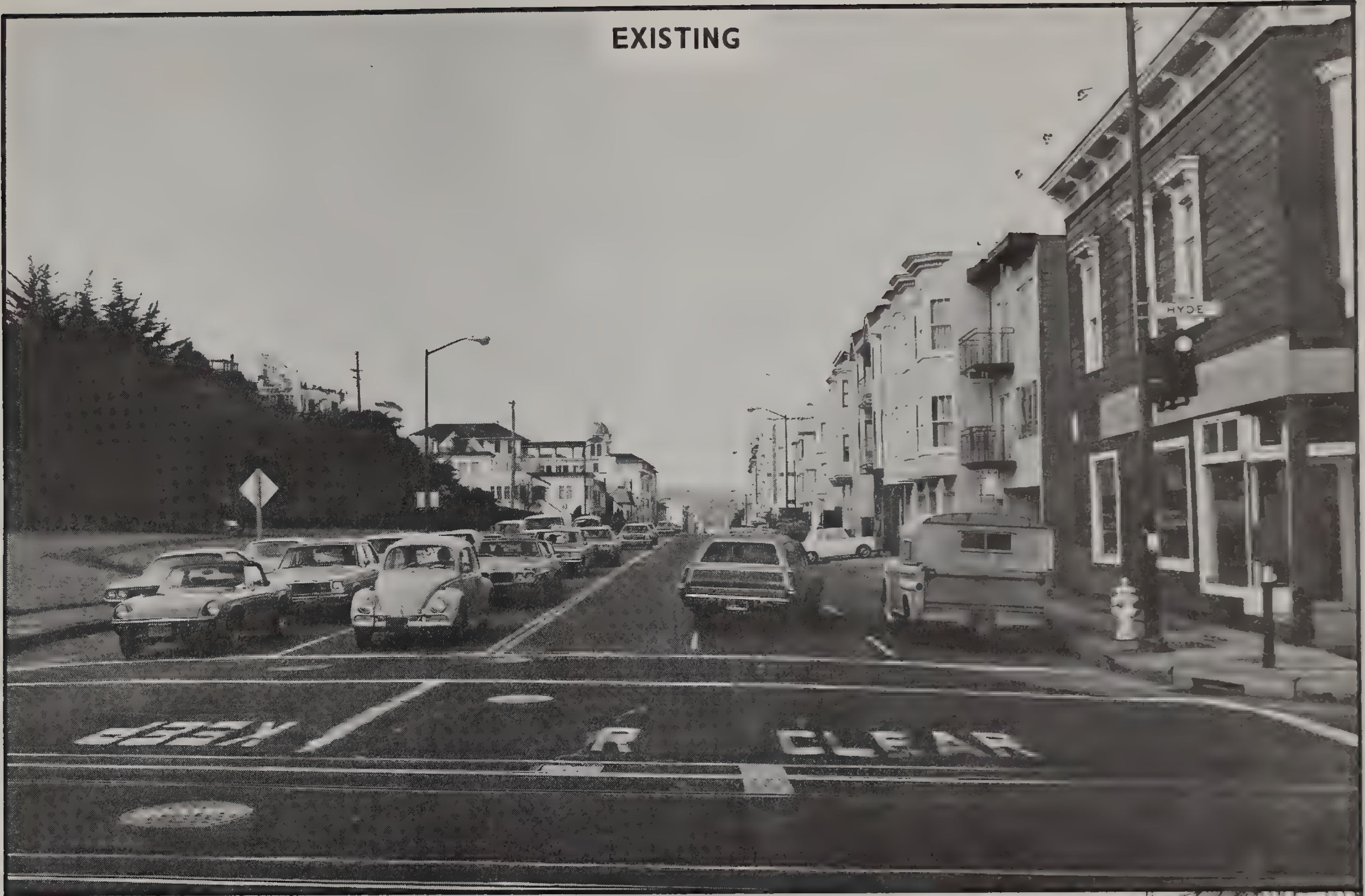
KAISER ENGINEERS

The reversible lane on North Point Street would require new traffic control devices. A stop sign for eastbound traffic on the Embarcadero would be needed to allow the buses to make the left-hand turn from the Embarcadero to North Point Street in the evening. Left turns from North Point Street onto the Embarcadero would be prohibited and a new traffic signal would be installed on the Embarcadero at Bay Street. The stop light on North Point at Hyde Street should be replaced by a cable car-actuated traffic light, similar to the one on Bay Street.

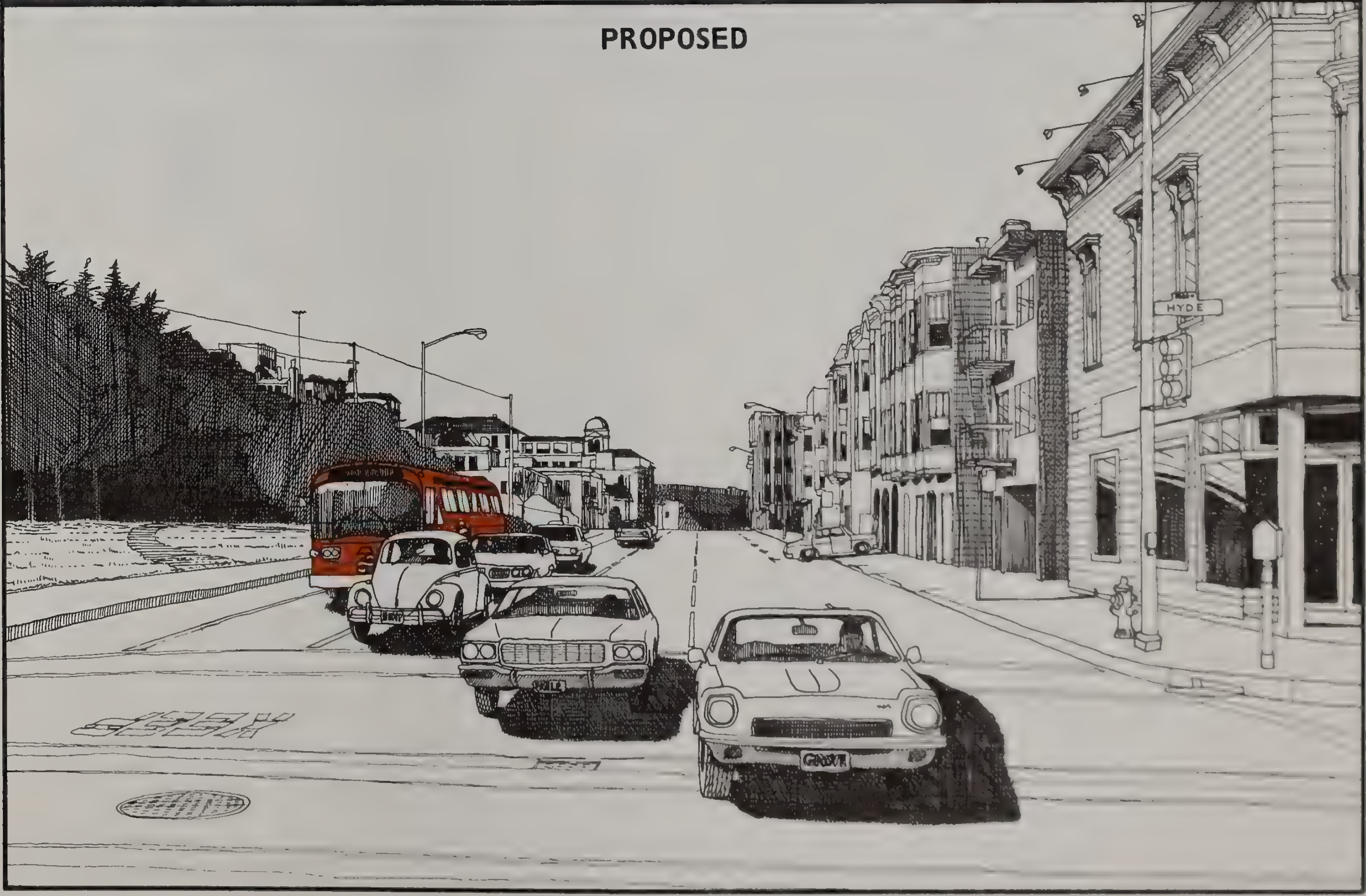
The reversible bus lane would save about 1.8 minutes over existing travel time and generate an increase of about 1-1/2% in bus patronage which is about 90 new passengers. The estimated cost of signing and striping is $299,000. The control signs must be changeable by either lights or mechanical movement to indicate when the center lane reverses to the morning bus operations as autos are using this lane in the western direction at other times.

b) North Point/Bay Streets One-Way Couple Reserve Bus Lanes

The one-way couple alternative depends on actions taken by the City of San Francisco concerning auto traffic on Bay and North Point Streets. If the City changes Bay and North Point Streets to a one-way couple, the Golden Gate buses could operate in a right-hand reserve bus lane, as shown in Figures V-13 and V-14. This alternative has the advantage of maintaining the bus stops at Hyde Street and Taylor Street. However, the bus lane would be interrupted by autos making right-hand turns or parking. The intersection at the Embarcadero, which is discussed in the next section, would be much simpler and less restricted for this alternative than for the reversible North Point alternative. The initial time savings over the present bus route would be about 2.0 minutes. This



EXISTING



PROPOSED

NORTH POINT / BAY ONE WAY COUPLE - BAY STREET

FIGURE V - 13

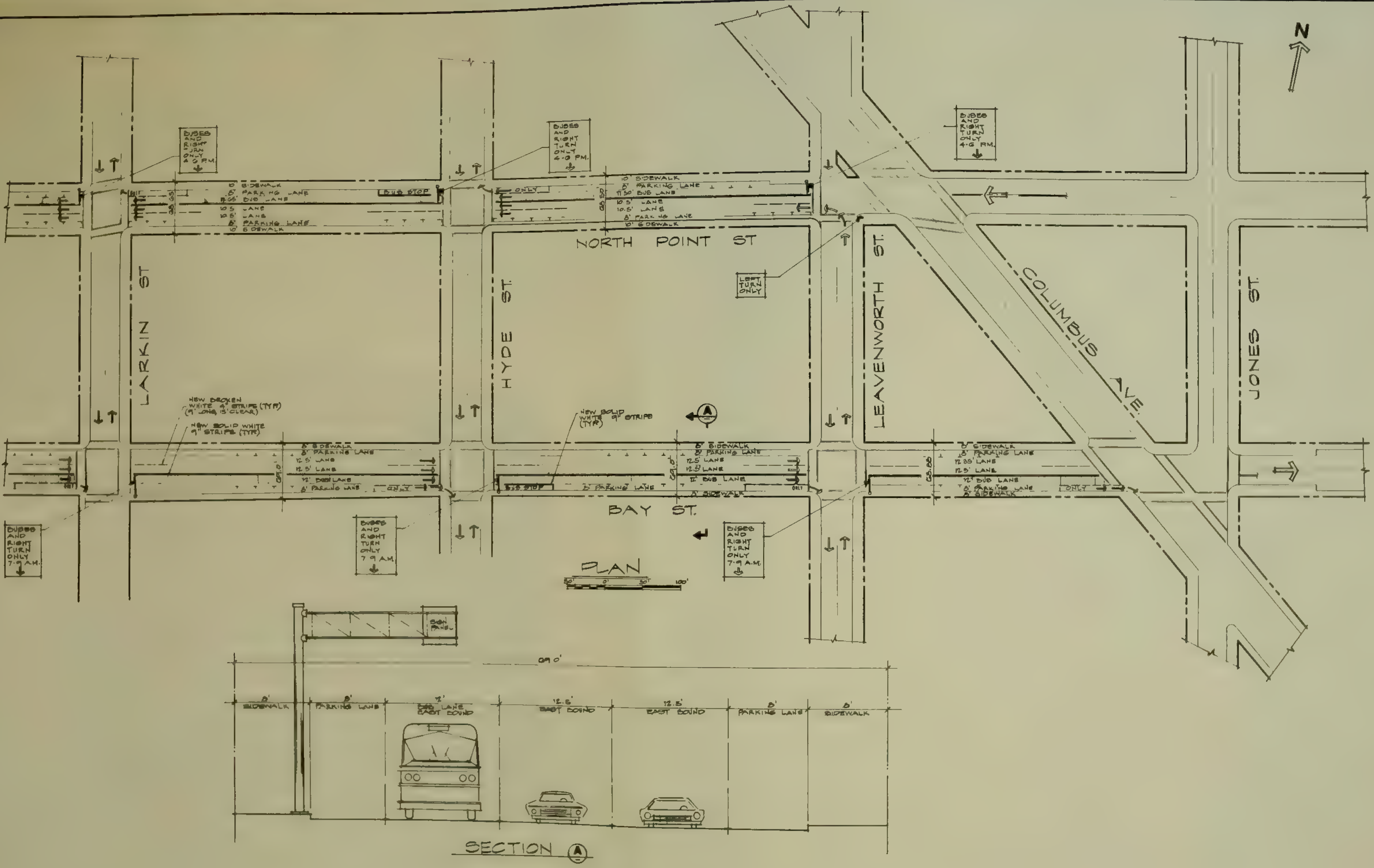


FIGURE V 14

NORTH POINT/BAY ONE-WAY COUPLE WITH RESERVED LANES

KAISER ENGINEERS

would correspond to a 1.7% increase in patronage which is 110 new bus passengers. The signing and striping cost estimate is $203,000. This cost is for the reserve bus lane only and does not include the cost of changing Bay and North Point Streets into the one-way couple.

A contraflow reserve bus lane on the one-way couple is also a possible solution to improving bus operations. The advantage of the contraflow bus lane is that it does not reduce peak direction auto capacity on the one-way couple, and does not have interference from parking or right-hand turning autos. The parking next to the contraflow bus lane would have to be eliminated during the bus lane operation.

3. Existing Environment

The existing bus route and the alternative routes being studied in this segment are located on major east-west arterials lined with mixed residential and commercial land uses. However, the section of Bay Street west of Columbus Avenue is predominantly residential. Trucks and buses are currently restricted on this section of Bay Street. MUNI operates buses on both North Point and Bay Streets. Major transportation destinations are Ghirardelli Square, the Cannery, Cost Plus, and Fisherman's Wharf.

The bus route is located between the Russian and Telegraph Hill residential neighborhoods and the Ghirardelli Square and Fisherman's Wharf Commercial District. Building form is generally low-rise attached structures which do not exceed 40 feet in height.

The three census tracts in this area have a total population of 7,197 which are socially and economically varied. Median family income is $14,000, which is $3,500 more than the city average. The percentage of families below the poverty level (10.2%) is slightly higher than the city average (9.9%).

Dwelling units in this area are predominantly rental. Only 17% of the dwelling units in this area are owner occupied while the city average is 31%. A significantly lower percentage of families in this area have children less than 18 years old (27%) compared with the city average of 48%.

During the period between 1970-1990, employment in the area is projected to increase by approximately 1,600 persons, representing a 16% growth. Office development in the Northern Waterfront Area has already anticipated much of this growth and is undergoing intensive development. Population growth is expected to be minor.

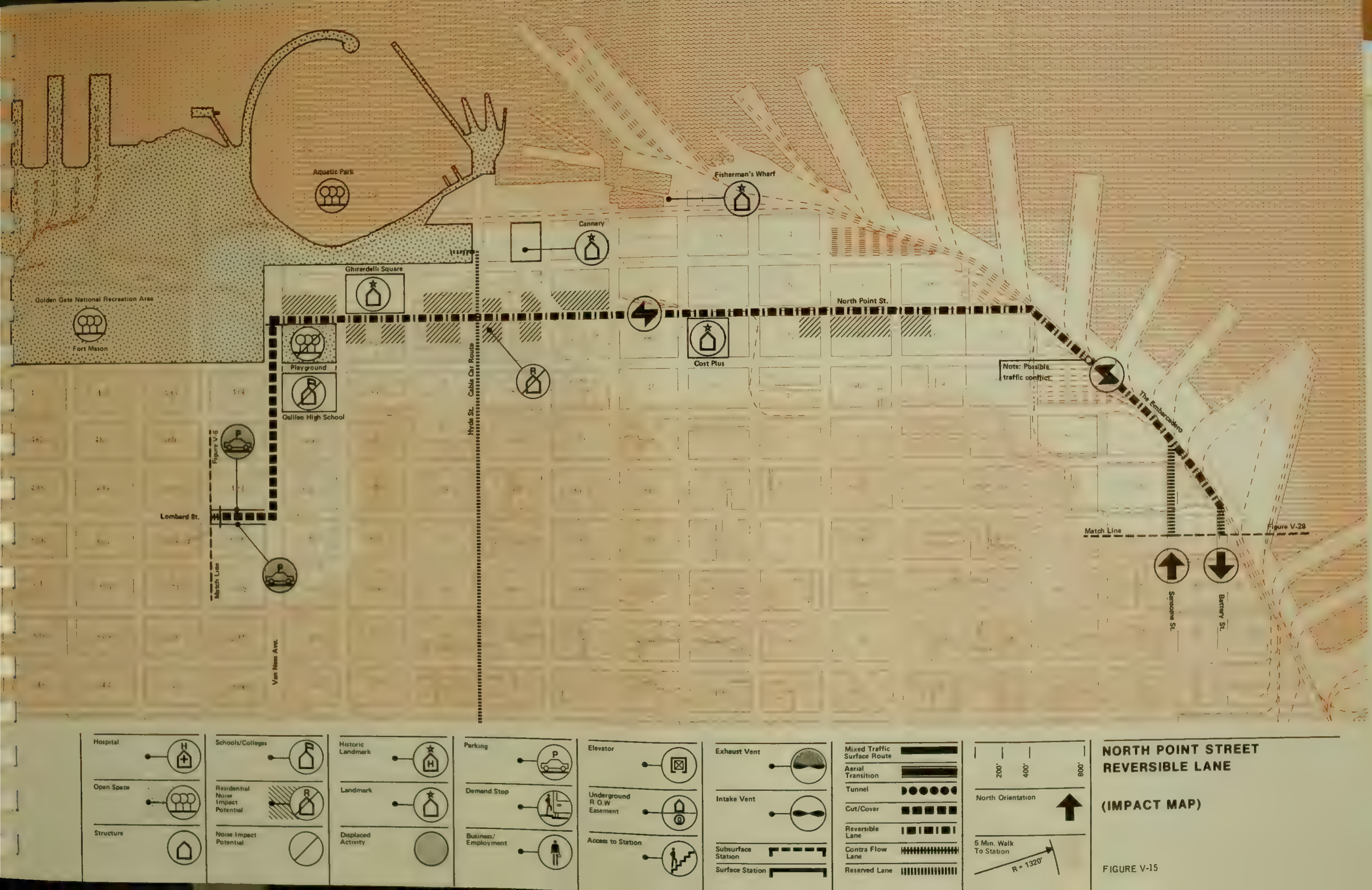
4. Impacts of the North Point Reversible Bus Lane

The impacts of the North Point Reversible Bus Lane are shown graphically in Figure V-15.

a) Disruption

The bus operations on North Point Street could create disruptions to both the residential and commercial activities along the street. There will be a noise impact to the residents, especially on the grade between Columbus Avenue and Hyde Street. Golden Gate buses currently operate on this section of the street so this would not be a new noise to the residents. However, the frequency of the buses will increase making the bus operation potentially more objectionable. The replacement of the stop sign at Hyde Street with a cable car stoplight would help reduce the frequency of accelerating buses at this intersection. Currently, bus noise levels reach as high as 87 dBA at the property line when accelerating from this intersection.

Extending the bus operations to the section of North Point Street east of Columbus Avenue will disrupt the high amount of pedestrian activity between the commercial activities located on both sides of North Point in this area both by creating potential psychological barriers and by safety hazards. Westbound MUNI operations would also be impacted due to the loss of one traffic lane for autos.



NORTH POINT STREET REVERSIBLE LANE

(IMPACT MAP)

FIGURE V-15

b) Visual

Two traffic signs per block will be required to indicate traffic restrictions during the operation of the reversible lane. The signs must be cantilevered from the sidewalk over to the center lane, and thus would require a massive structure. These signs may prove to be unsightly and out of context with the residential and commercial scale and character of the area. These signs are illustrated in Figure V-11.

c) Accessibility

The elimination or reduction of direct Golden Gate bus service to bus stops in this area would reduce the transit accessibility to the employment and recreational facilities in this area. The reverse commute and recreational trips from this area would not be affected since most of the trips would be made at times or in directions when buses would not be operating in the reserve bus lane and would therefore make the stops.

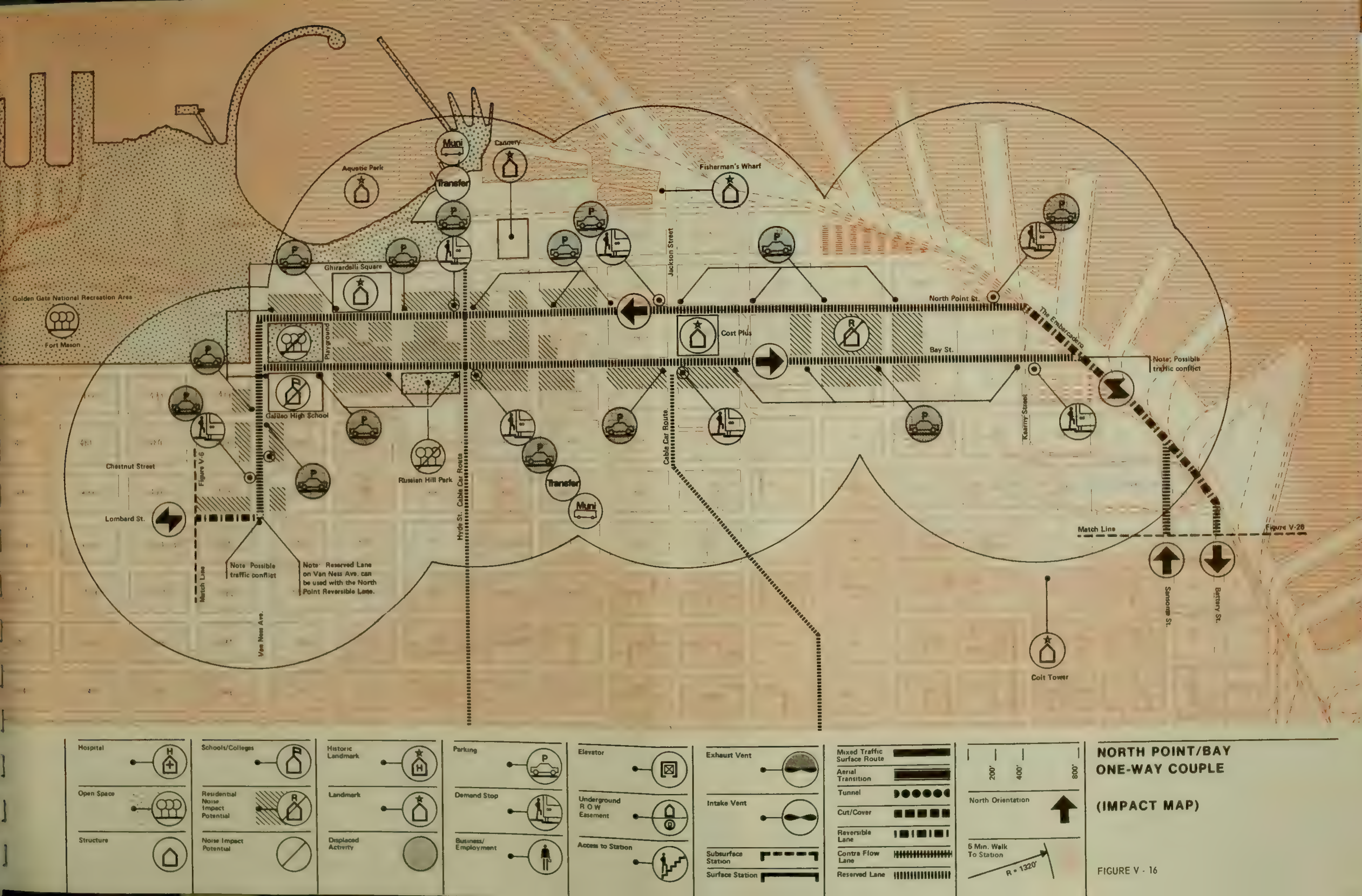
The reduced Golden Gate service to this area could slow the forecasted employment growth.

6. Impacts of the North Point/Bay One-Way Couple Reserve Bus Lanes

The impacts of the North Point/Bay Streets Reserve Bus lanes are shown graphically in Figure V-16.

a) Displacement

Approximately 65 parking spaces will be displaced on North Point and Bay Streets during the respective peak periods.



NORTH POINT/BAY
ONE-WAY COUPLE

(IMPACT MAP)

FIGURE V - 16

b) Disruption

The physical impact of buses on North Point Street in the vicinity of commercial areas around Cost Plus will be similar to that described for the North Point reversible route alternative.

c) Visual

Visual impact of traffic control signs will be less than that discussed under the North Point reversible alternative because signs are smaller. However, the signs would be required on both Bay and North Point Streets. Signs will add to the visual clutter and may be inappropriate for residential portions of the route, particularly Bay Street west of Columbus. In addition trolley wires would be required on Bay Street for MUNI operations.

d) Land Use

Continued Golden Gate bus stops in this area would help encourage further office development on the Northern Waterfront by providing an added amenity to prospective office space tenants. However, it is not expected that Golden Gate service would induce any office growth beyond that already projected.

Implementation of a surface system involving reserve bus lanes on North Point and Bay could have a significant adverse impact on retail land uses, especially the sales of service establishments which depend on automobile traffic similar to the impact discussed under the Lombard reserved lane segment. There are 36 service retail establishments on North Point and Bay. Substantial annual retail sales could be lost because of reserved right lanes on North Point and Bay Streets. For further details see Appendix VIII.

e) Public Policy Implications

San Francisco's Comprehensive Plan recommends the conversion of Bay and North Point Streets to a one-way pair in the Northern Waterfront Plan. While this Plan is official public policy, members of this project's Citizen Advisory Panel have strongly disagreed with the City's policy for fear that a one-way treatment of these streets will increas auto traffic volumes and seriously impact the neighborhood area along North Point Street.

c. The Embarcadero

1) Existing Conditions

The existing bus operation on the Embarcadero does not present any major problem. Buses travel the one quarter mile distance from Bay Street to Battery Street in 0.8 minutes at an average speed of 20 mph. Traffic conditions are about at Level D. The principal restriction is the evening stop light at Sansome Street and the Embarcadero. However, the 21 seconds of green in the 70-second cycle will handle buses at a rate of 200 per hour (assuming a reserve bus lane on Sansome). This is sufficient capacity to handle the expected bus load past the year 2000 since only two-thirds of the Financial District buses will be coming from Sansome Street. The other one-third will be coming directly from the Transbay Terminal via the Embarcadero.

The new stop light required at Bay Street with the North Point reversible bus lane would not restrict the bus capacity since the signal could be set to allow the heavy volume of morning traffic turning right onto the Embarcadero and the eastbound buses in the left lane to go at the same time.

2) Proposed Improvements

A reversible one-way bus lane could be implemented if traffic conditions on the Embarcadero were to become congested. The bus lane, shown in Figure V-17 , would

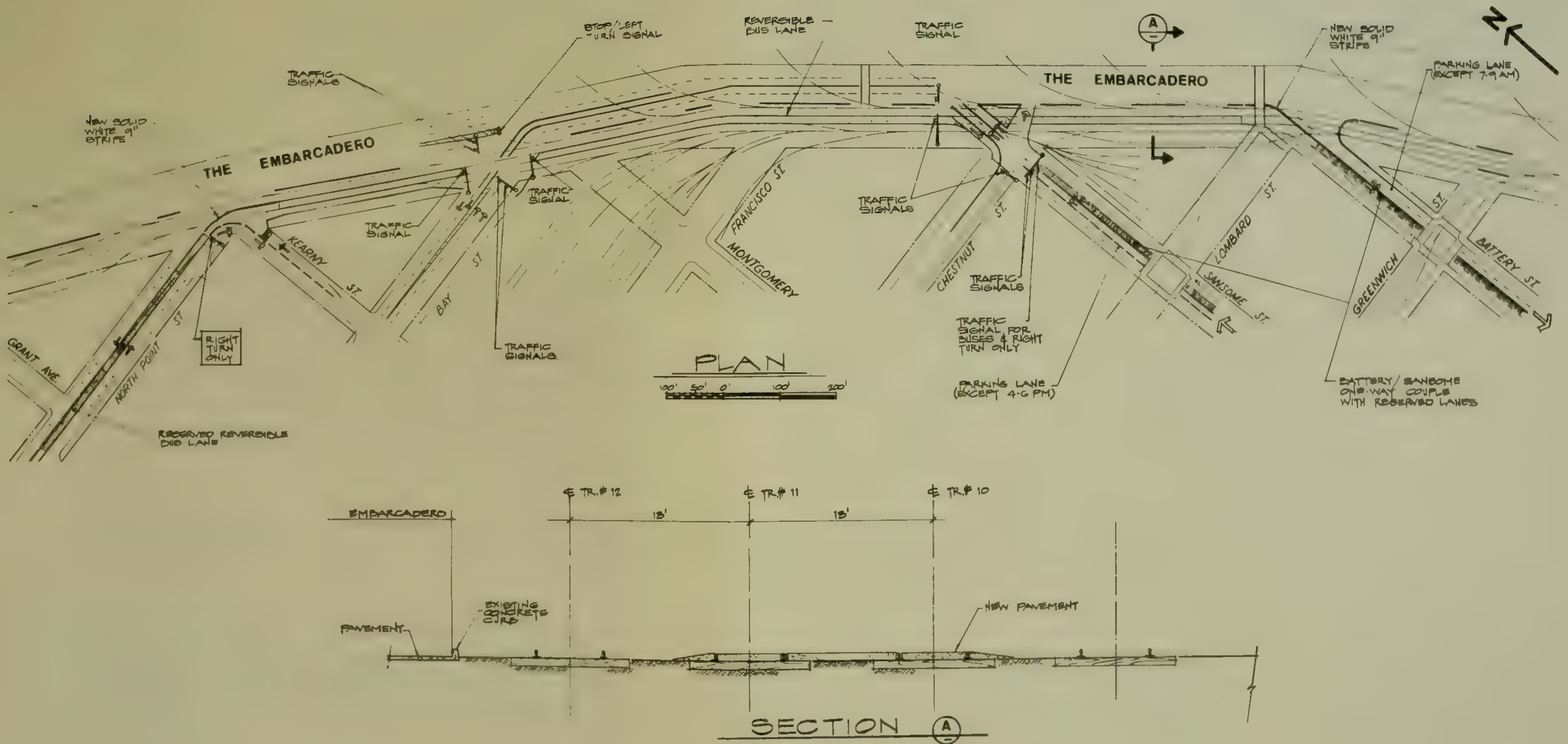


FIGURE V-17

THE EMBARCADERO REVERSIBLE LANE

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be on the west side of the Belt Line Railroad tracks. Two of the four tracks would be paved over to provide the bus lane. The new traffic light at Bay Street would be set so the buses could cross the heavy traffic flow between the Embarcadero and Bay Street. This traffic light would eventually limit the bus capacity since the high auto traffic volume and the bus route cross and therefore buses and autos cannot go at the same time. In the evening the stop light at Sansome Street would allow the buses to make a left turn onto the bus lane from the right-hand lane of Sansome Street on a red light.

There would be no time savings with the reserve lane over the existing travel times; in fact, the times might be slightly longer due to the traffic light at Bay Street.

The cost of paving, signing, and striping for the reversible bus lane is estimated to be $239,000.

If the one-way couple were implemented on Bay and North Point Streets, the best location for a reserve bus lane on the Embarcadero would be the right-hand traffic lane in the eastbound direction and the middle lane in the westbound direction. The buses would be flowing with the peak traffic volume with no need to cross the traffic. Through traffic on the Embarcadero would be permitted to merge through the bus lane.

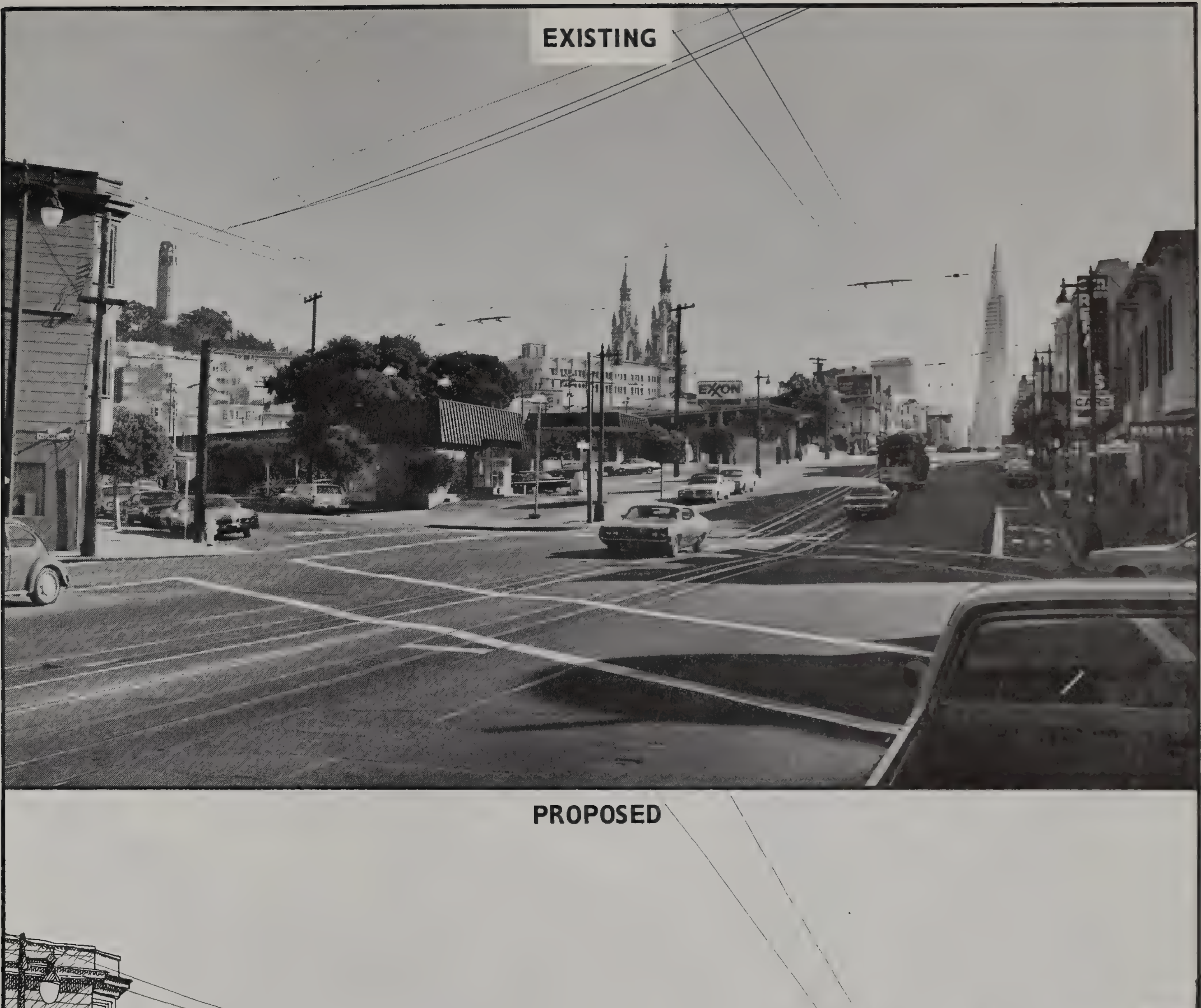
Future port development and roadway improvements may present new opportunities and constraints for bus operations on the Embarcadero.

3) Impacts

Other than possible restrictions on operations of the Belt Line Railroad during peak periods, and the traffic implications already discussed, there are no significant impacts expected from the bus improvements discussed above.

d. Lombard Tunnel

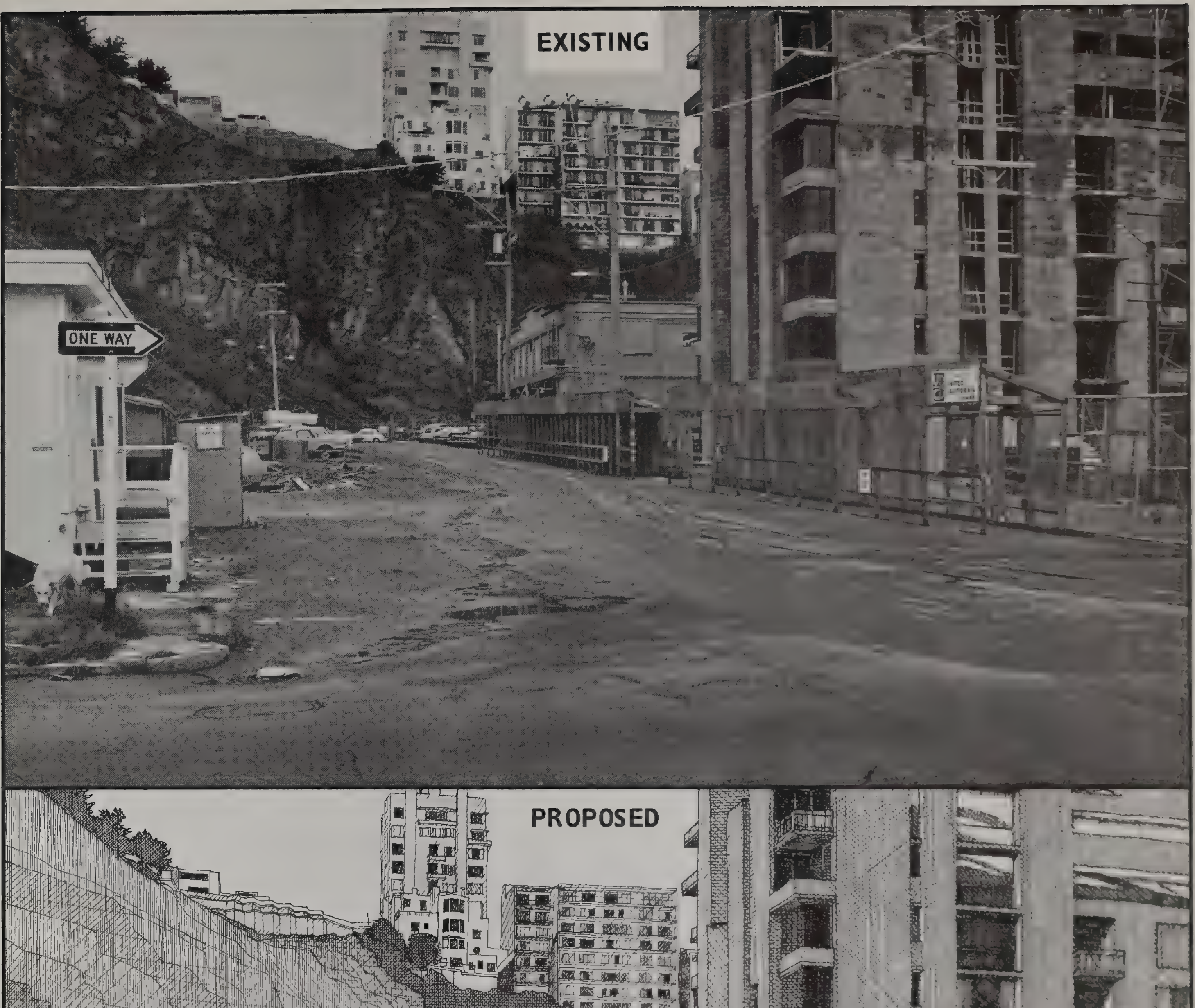
A reversible one-way bus tunnel beneath Russian and Telegraph Hills, shown in Figures V-18A, V-18B, and V-19, is proposed as a possible solution to bypass the congestion and neighborhood impacts along Van Ness Avenue and North Point Street.


EXISTING

PROPOSED

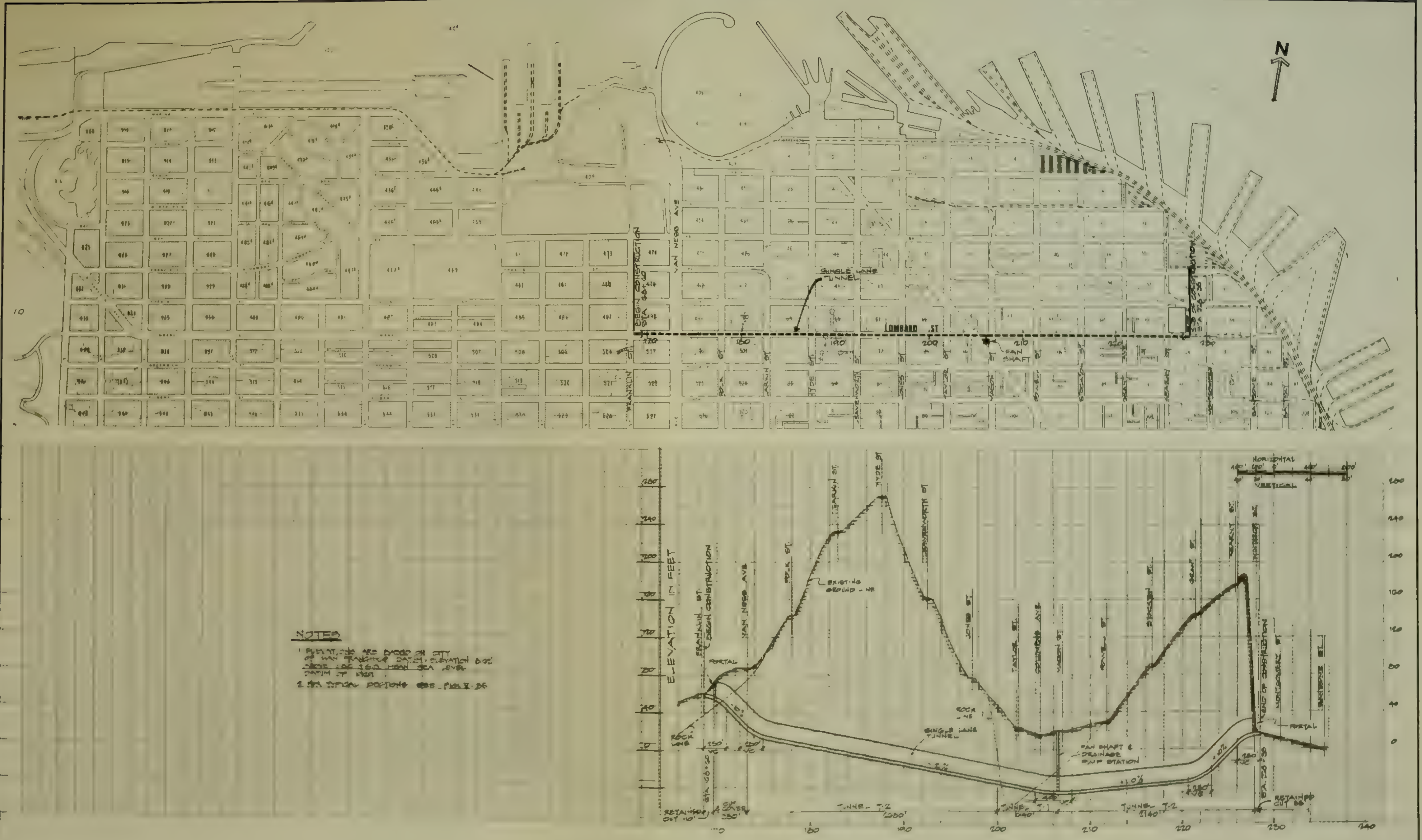
TUNNEL VENT STRUCTURE AT LOMBARD AND COLUMBUS

FIGURE V - 18A



LOMBARD SINGLE LANE TUNNEL,
EASTERN PORTAL AT WINTHROP

FIGURE V - 18B



NOTES

1. ELEVATIONS ARE BASED ON CITY OF SAN FRANCISCO DATUM - ELEVATION 0.0' ABOVE [illegible] MEAN SEA LEVEL DATUM OF 1929.

2. FOR TYPICAL SECTIONS SEE FIG. V-36

FIGURE V 19

LOMBARD SINGLE LANE TUNNEL

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1) Route Description

The tunnel would begin in the center of Lombard Street between Franklin Street and Van Ness Avenue. The portal's design would be similar to the underpass shown in Figure V-18 and would be compatible with the contraflow bus lane on Lombard Street.

The 1.1-mile tunnel would exit on Lombard Street between Kearny and Montgomery Streets and would contain a 13-foot lane. Typical sections are shown in Figure V-35, following page V-36. An exhaust vent shaft would be required at Columbus Avenue.

Buses would take 1.9 minutes to travel from Lombard at Van Ness to Battery Street via the tunnel. The existing travel time for this segment is 7.8 minutes and could reach 12 minutes by 1990. The tunnel would save 5.9 minutes over today's travel time. This time savings would increase bus patronage by about 5% which is 320 new bus riders.

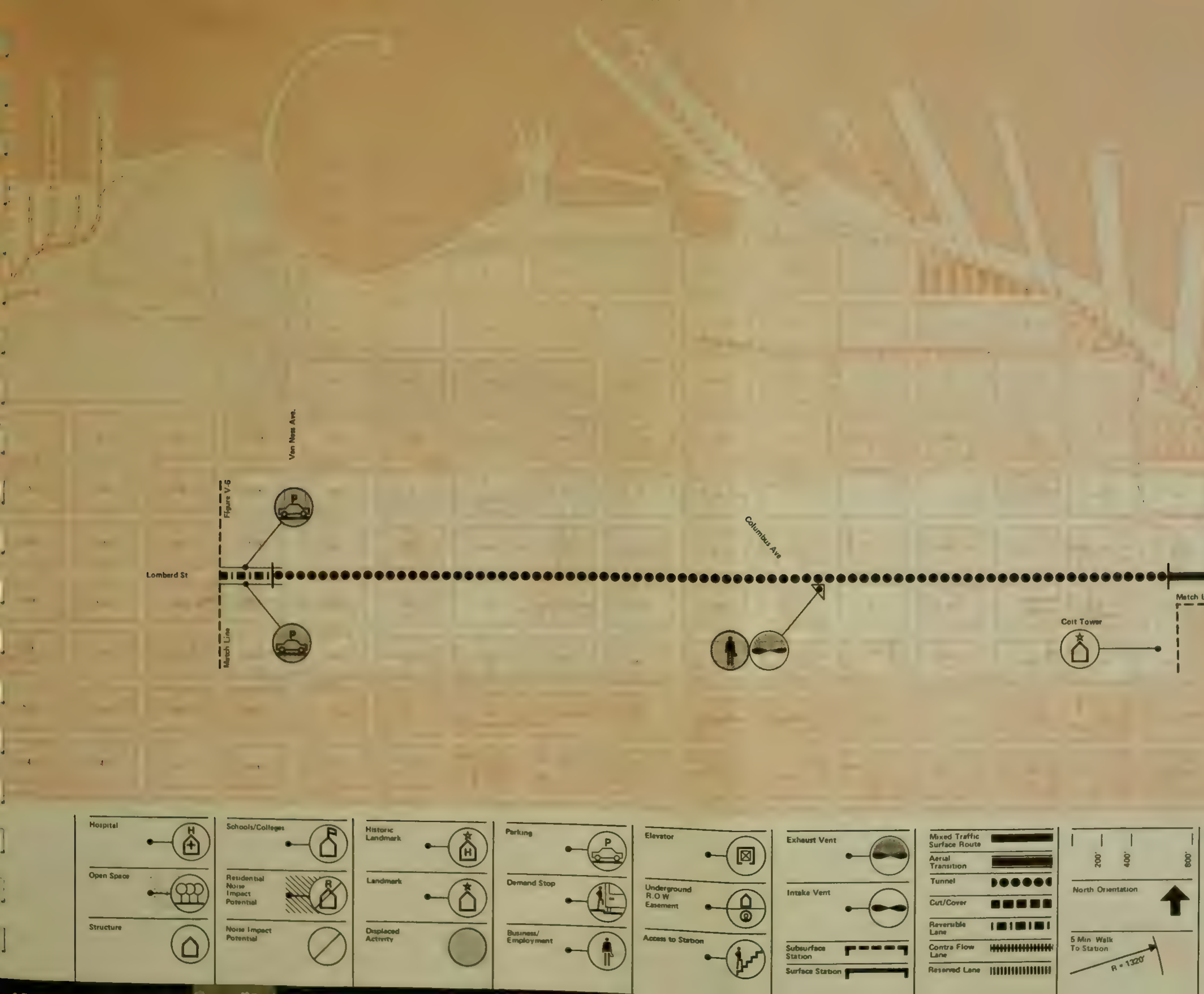
The cost estimate for the tunnel is $23.5 million in 1975 dollars. The tunnel is planned so that it could eventually be part of the underground exclusive busway from The Presidio to the Financial District which is described in Section VC of this report.

2) Impacts

The impacts from the tunnel are shown in Figure V-20.

a) Construction

There will be major construction disruptions at both tunnel portals. The west portal will restrict traffic flow on Lombard Street between Van Ness Avenue and Franklin Street. Most of the construction disruption will be due to the traffic and noise from trucks hauling away excavated materials. The estimated time period for construction is 2-1/2 years.



LOMBARD SINGLE LANE TUNNEL

(IMPACT MAP)

FIGURE V - 20

b) Disruption

The area likely to suffer the most disruption from the tunnel is at the east portal. This portal, on Lombard Street near Winthrop Street, is located on the Northern Waterfront Area adjacent to a planned high density residential development a portion of which is presently under construction. Noise and safety hazards may occur to the planned residential development depending on the site design.

c) Displacement

Approximately 15 parking spaces will be displaced to accommodate the west portal of the tunnel on Lombard between Franklin and Van Ness. The tunnel exhaust vent structure located in the vicinity of Lombard and Columbus will displace a gasoline station employing approximately five persons.

d) Visual

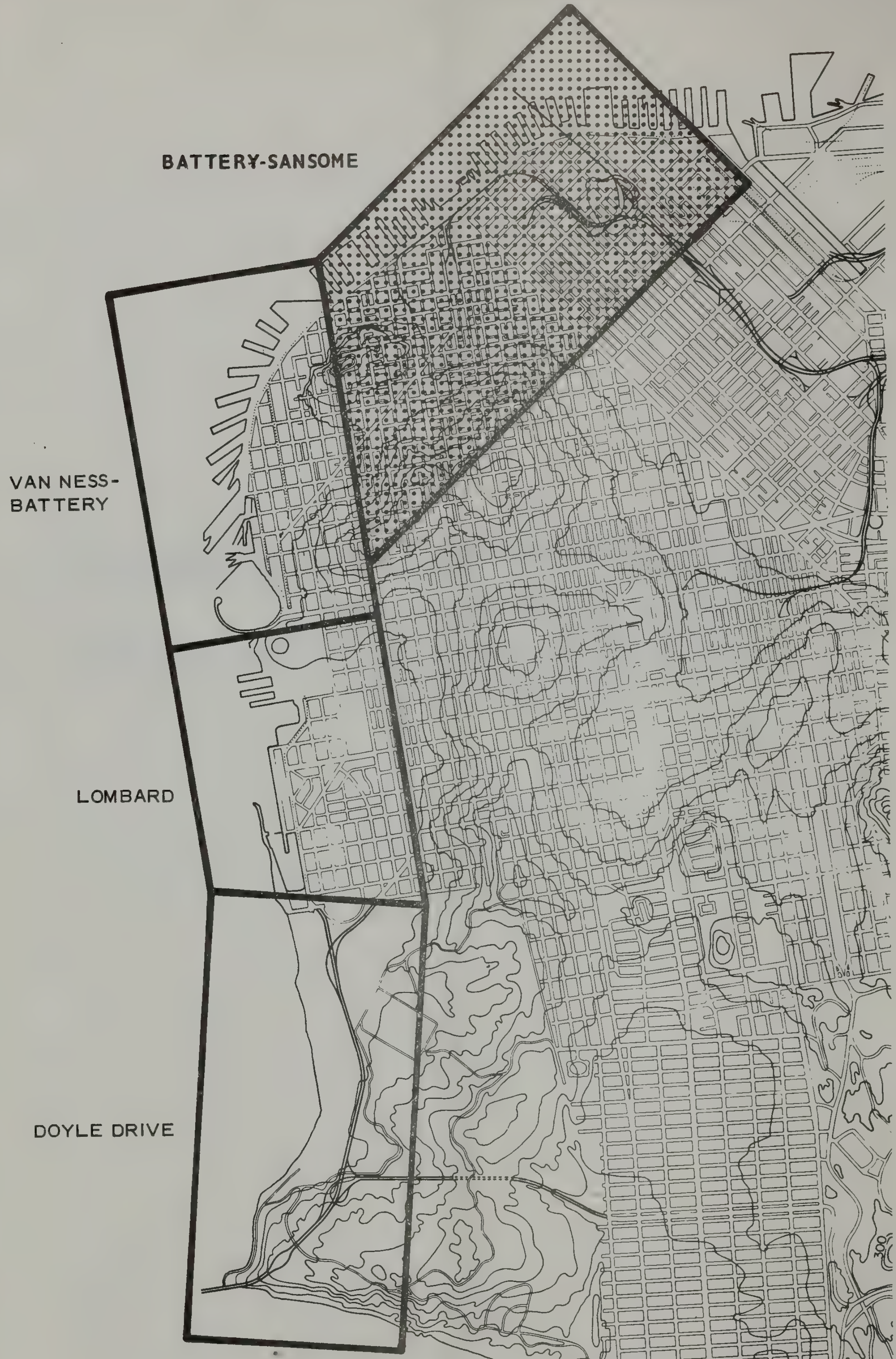
The only visual elements in this segment are the west and east tunnel portals and exhaust vent structures. The architectural treatment of the portals is illustrated in Figures V-8 and V-18A and B. The tunnel portals are expected to have minimal adverse visual impact.

e) Accessibility

The tunnel route will have no stops between Van Ness Avenue and Battery Street and, therefore, will have the same accessibility impact as the North Point Reversible Lane alternative, described on page V-23.

BATTERY/SANSOME SEGMENT

- Reserved Bus Lanes
- Financial District Loading Zones


BATTERY-SANSOME
VAN NESS-BATTERY
LOMBARD
DOYLE DRIVE
300

4. FINANCIAL DISTRICT SEGMENT

The Financial District segment includes the 0.9 miles from the Embarcadero to the Transbay Terminal via the Battery/Sansome Street one-way couple including the Financial District loading and unloading areas.

a. Existing Conditions

The Golden Gate buses travel the 0.9-mile route to the Financial District bus stops from the Embarcadero via the Battery/Sansome Streets one-way couple and then continue across Market to the Transbay Terminal.

Battery Street is carrying about 1,100 vehicles during the morning peak hour, making the street relatively congested (Service Level D). It takes the buses about 7.6 minutes including unloading time to reach Market Street and another 1.4 minutes to reach the Transbay Terminal via First Street. An 18% growth in traffic to 1,300 vehicles per hour would put traffic conditions on Battery Street at Service Level E, or require restricted parking. At Service Level E bus travel times would increase by approximately 0.7 minutes.

The most limiting intersection on Battery Street is at Broadway where a freeway exit ramp exists. The traffic light is green for Battery Street only 20 seconds in the 80-second cycle. This could limit bus capacity under mixed traffic conditions. However, with a reserve bus lane, bus capacity at a rate of 180 buses per hour could be maintained. This is well beyond the expected rate for the year 2000 for this section of the bus system.

In the evening, buses cross Market Street from Fremont Street to Front Street, make a left turn onto Pine Street, travel two blocks on Pine Street to Sansome Street where they turn right. Pedestrian flows and the tight right turn from Pine Street to Sansome Street make this congested and restricted for bus movement. The traffic conditions on Sansome Street are at Service Level C which is relatively good. The buses take only 5.3 minutes including loading to travel the 0.9 miles from Pine Street to the Embarcadero. The major restriction is at Broadway where only 29 seconds of green light is available in the 80-second cycle. However, this should not be a restrictive factor for bus capacity.

At the present time, all Financial District buses take Battery and Sansome Streets to the Transbay Terminal. However, the GGBHTD is about to start direct service to the Transbay Terminal via the Embarcadero and Howard Street. Eventually the direct service to the Transbay Terminal should account for about one-third of the Financial District buses.

b. Reserve Bus Lanes

Reserve bus lanes on Battery and Sansome Streets in the right-hand lane, as shown in Figure V-21, would ensure that buses maintained their free flow, especially through the many intersections with traffic lights. A reserve lane on Battery Street would reduce existing travel time by about 1.2 minutes. The reserve bus lane in the vicinity of the unloading area is shown in Figure V-22. This would account for approximately 1% increase in bus patronage or about 40 new bus riders. The time savings on Sansome Street would be only 0.6 minutes since today's conditions are less congested.

The estimated cost of signing and striping the reserve bus lanes on Battery and Sansome Streets is $226,000.

c. Financial District Loading Areas

A major evening loading zone is required to serve the riders north of Market Street. Two alternatives were studied, each presenting different opportunities and constraints. One alternative is located on Front Street between Pine and Sacramento Streets and shown in Figures V-23 and V-24. The other alternative is located on Sansome Street between Commercial Street and mid-block between Pine and California Streets, and is shown in Figure V-25. Each loading zone is approximately two blocks long providing for 10 loading stalls. Both loading zone alternative locations will provide bus shelters for added passenger comfort.

The Front Street Loading Area has the following opportunity:

- Front Street which is not a through street has low traffic volumes. Consequently some of the existing street width can be used to widen pedestrian sidewalks and reserved bus lanes without conflicting with existing traffic flow.

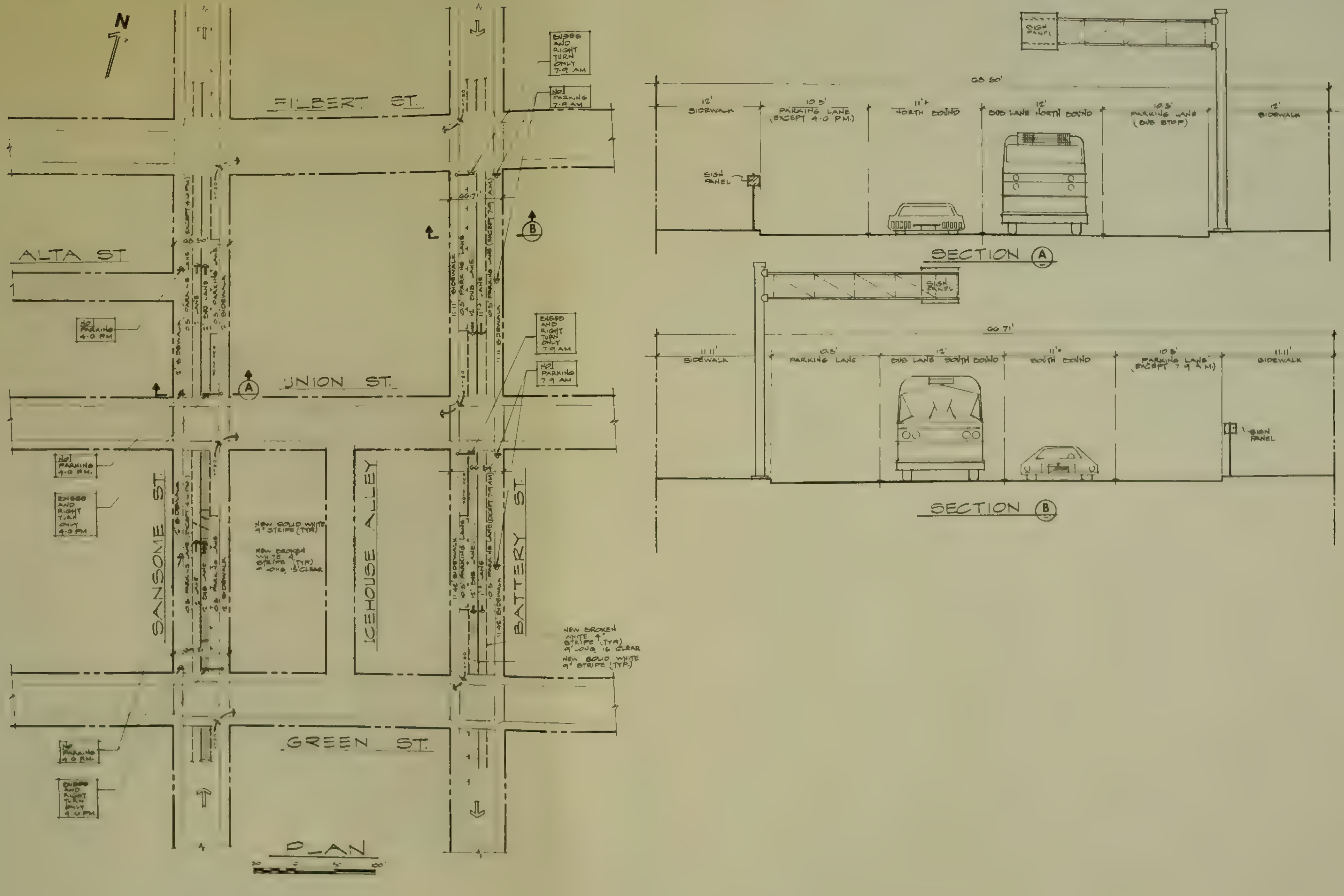


FIGURE V 21

BATTERY/SANSOME ONE-WAY COUPLE WITH RESERVED LANES

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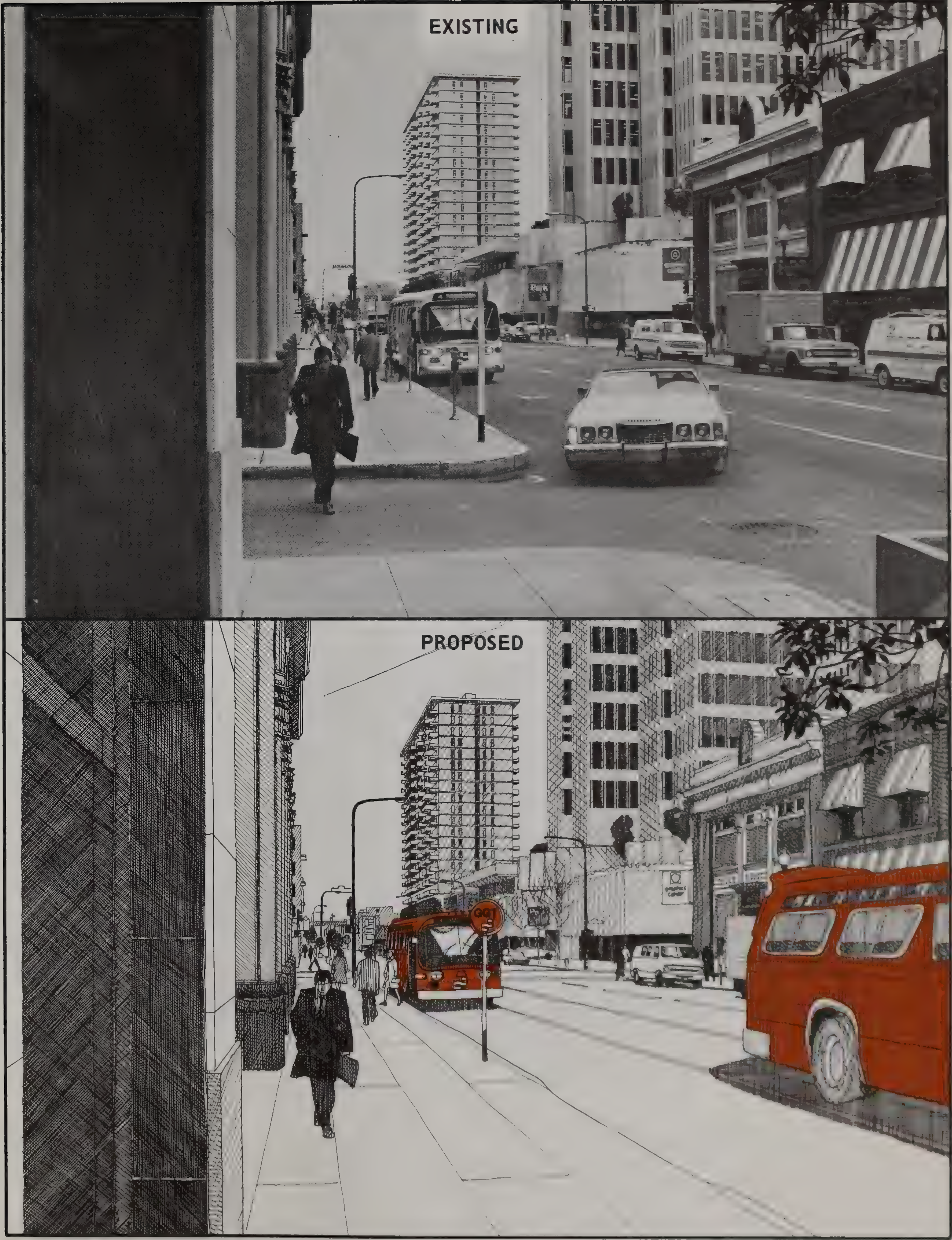
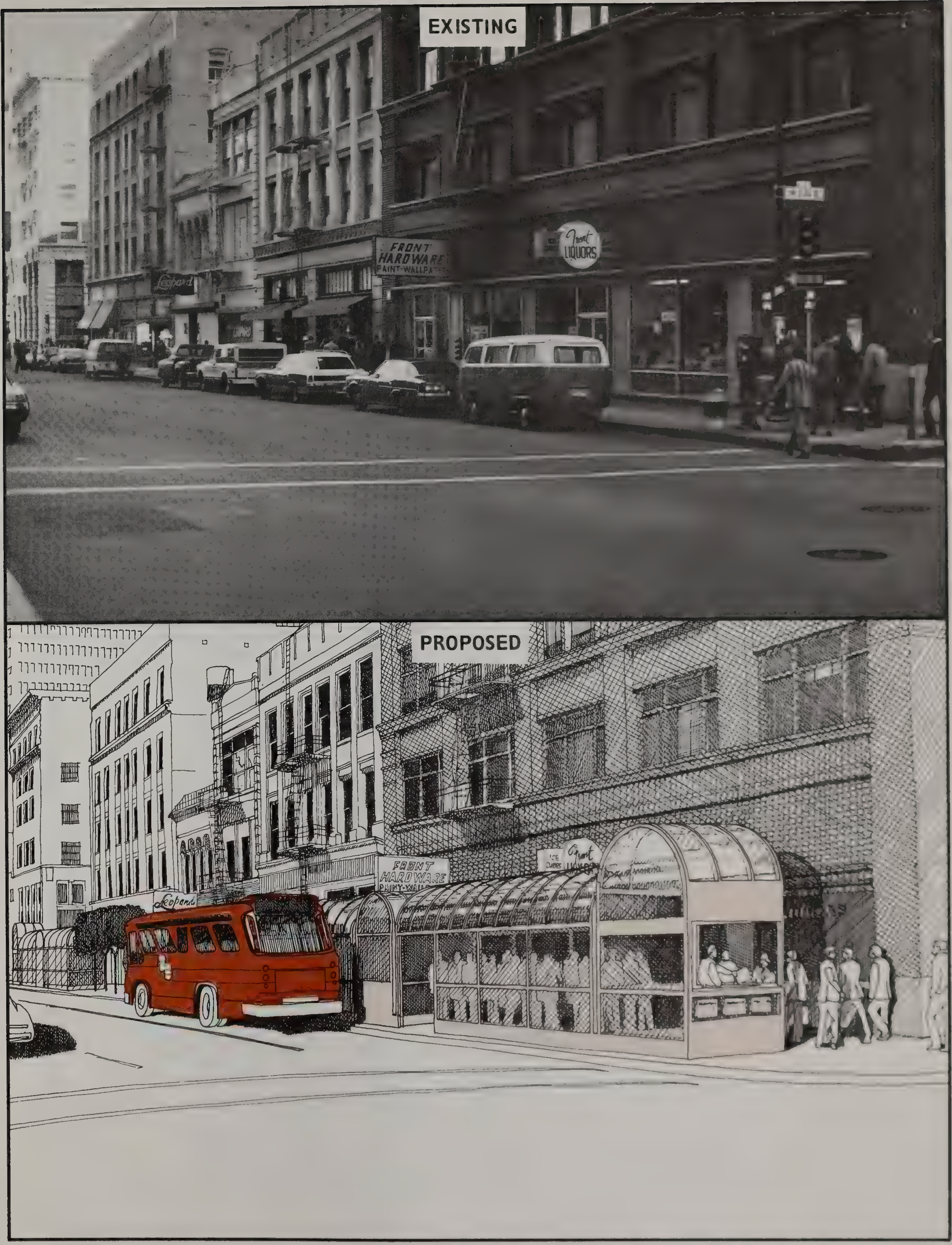


BATTERY STREET
FINANCIAL DISTRICT A.M. LOADING ZONE

FIGURE V - 22



FRONT STREET - FINANCIAL DISTRICT
P.M. LOADING ZONE

FIGURE V - 23

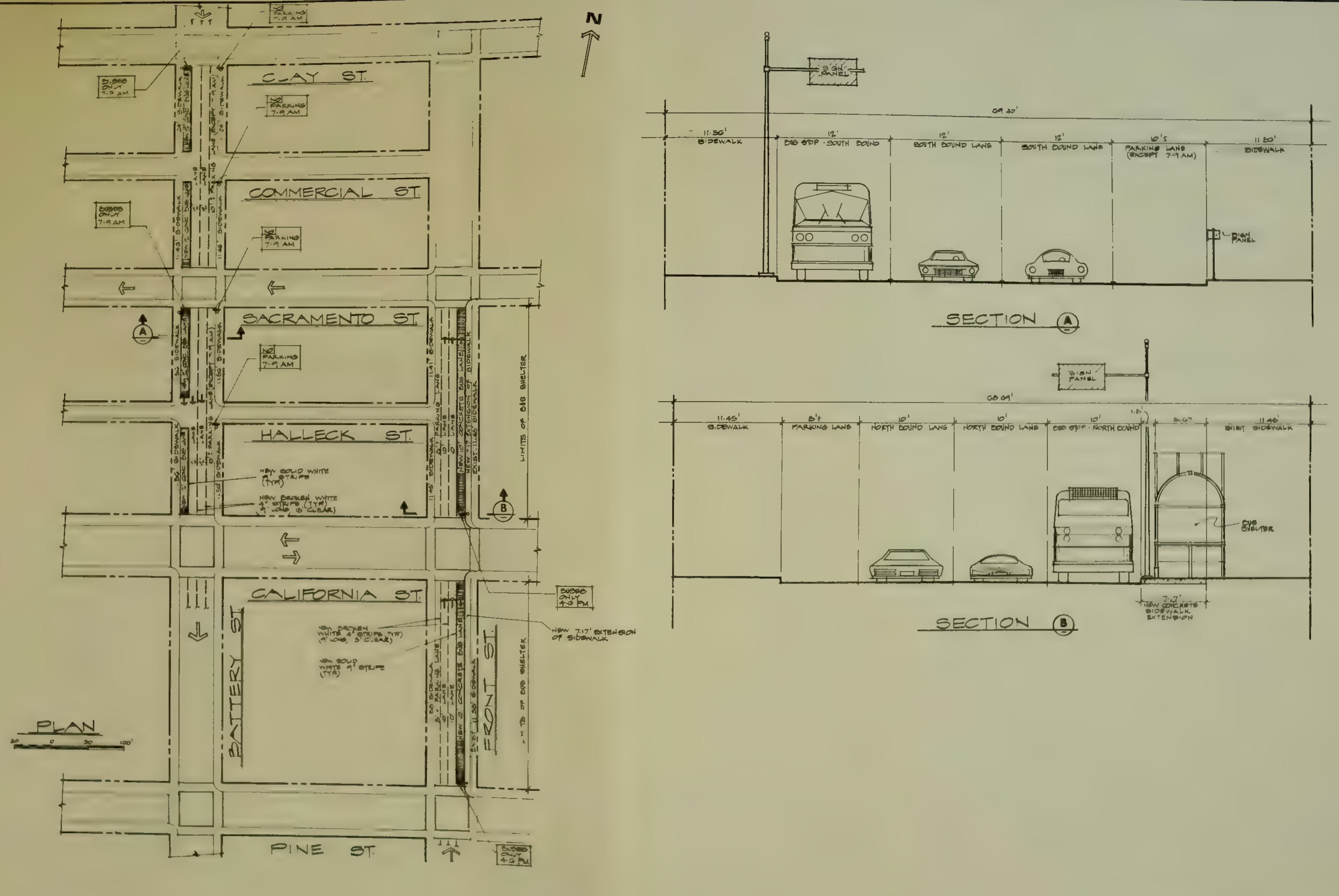


FIGURE V-24

FRONT/BATTERY FINANCIAL DISTRICT LOADING ZONES

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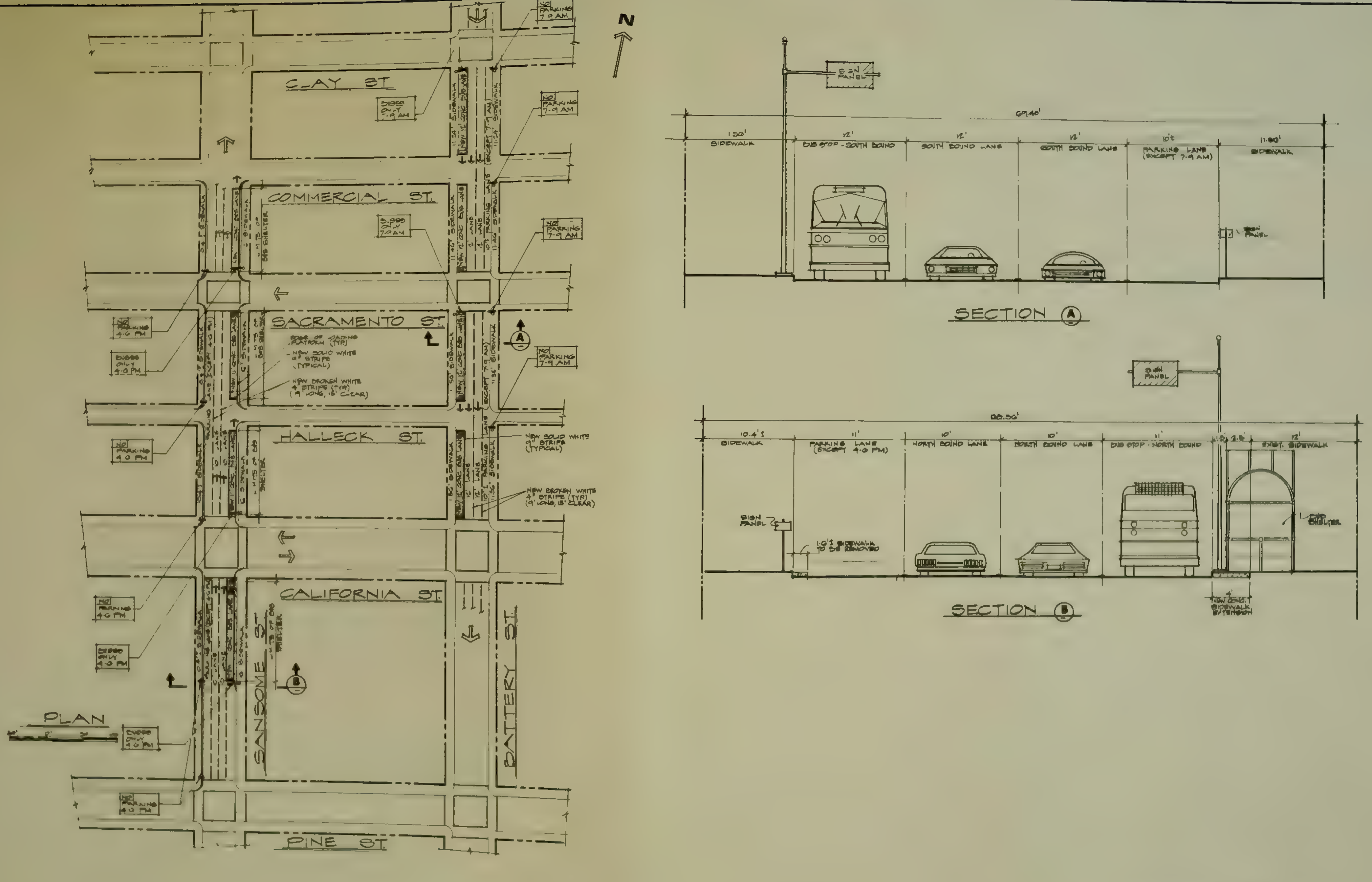

FIGURE V-25

BATTERY/SANSOME FINANCIAL DISTRICT LOADING ZONES

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However the Front Street Loading Area has the following constraints:

- The Front Street loading zone location overlaps the 5-minute walking distance service of both the Ferry and Transbay Terminals to a greater extent than the Sansome Street location.

- Buses turning on Sacramento Street enroute to Sansome Street may conflict with MUNI lines operating on Sacramento Street.

The Sansome Street Loading Area has the following opportunites:

- The Sansome Street loading zone location is similar to the current loading area which is familiar to current passengers.

- The Sansome Street location service area does not overlap that of the Ferry Terminal.

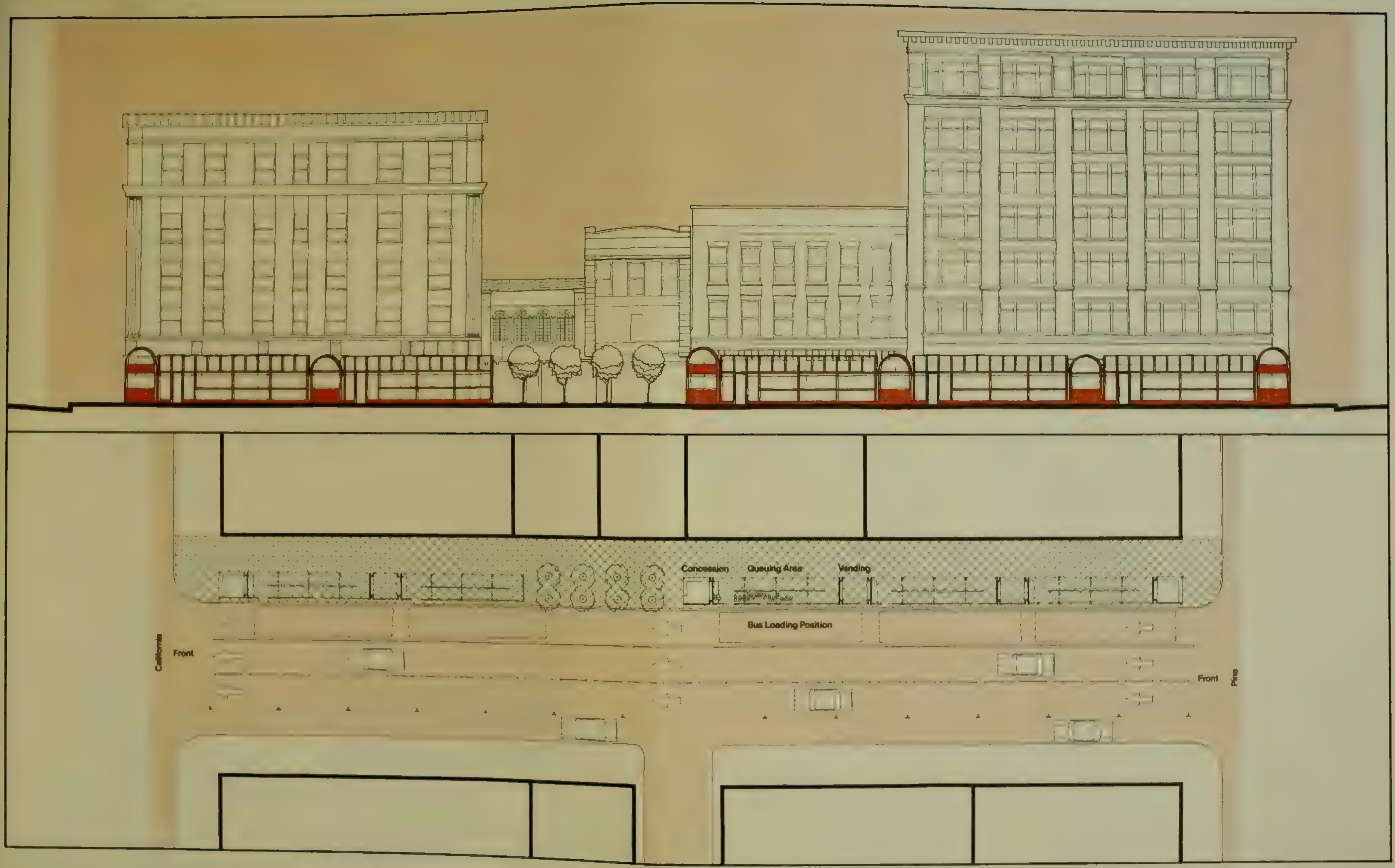
- The Sansome Street location serves the western portion of the Financial District to a much greater extent than the Front Street location.

However, the Sansome Street Loading Area also has the following constraint:

- Traffic volumes are very high on Sansome Street. Consequently a bus loading area will conflict with existing traffic to some extent. Extension of sidewalk to accommodate waiting passengers can only be accommodated at the expense of slightly reducing sidewalk width on opposite side of the street.

d. Financial District Bus Shelter

Bus shelters are an important factor of convenience and comfort to bus passengers. An example of a bus shelter at the Front Street loading location is shown in Figure V-26.



FRONT STREET - FINANCIAL DISTRICT LOADING ZONE WITH BUS SHELTER

FIGURE V-26

The sample bus shelter design is shown in Figure V-27. The materials are durable and easy to maintain. The architectural form of the shelters is expressly designed to visually communicate service offered by Golden Gate Transit. Distinctive graphics are planned to enrich the architecture of the shelter as well as indicate bus routes and other transit information. The clear lexan wall panels protect passengers from wind and bus splash on three sides. The shelter design accommodates up to 80 standees and seating for four passengers.

The lexan wall adjacent to the busway is on rollers and slides away during off-peak use to allow delivery to adjacent buildings. The row of shelters would be broken mid-block to allow delivery of large items which won't fit through the shelter.

The design requires that the sidewalks be widened to 16 feet to accommodate both the shelter and adequate walk way for pedestrial flow during peak periods. Environmental control features include radiant heating strips and adequate lighting for passenger convenience and security.

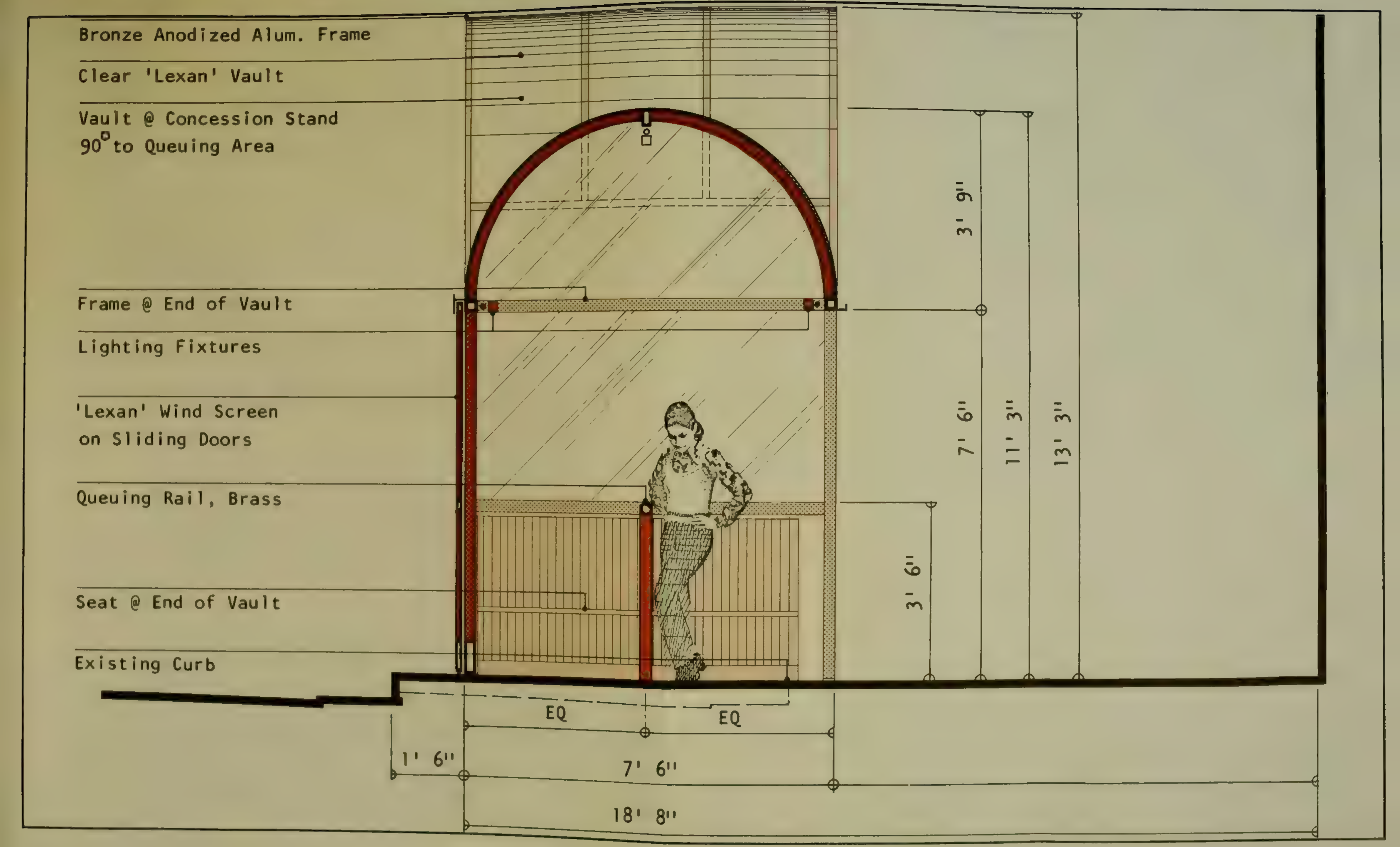
The estimated cost for this bus shelter design at the Sansome Street location is $686,000. Kiosks could also be incorporated into the bus shelters for newspaper racks, telephones, a dispatch agent, or commercial vendors such as flower stands.

The number of bus shelters can be easily expanded or reduced as they are designed as demountable modular units.

Further, if demand in the location decreases, the shelters can be moved to another location easily as they are affixed to the sidewalk in a nonpermanent way.

e. Existing Environment

The major land uses in the Financial District area are characterized by highrise buildings and dense employment. The portion of the route north of Washington Street includes Jackson Square, a historic district, and the Northern Waterfront, an area of professional offices and warehousing. Regional offices represent 37% of the land area in the Financial District near the route and 13% is used for parking.



TYPICAL BUS SHELTER - SECTION

FIGURE V-27

The segment lies within seven census tracts which have a total population of approximately 19,500 people. The median family income for residents is slightly higher than the city average. Homeownership in these census tracts is far lower than in other areas of the city, 5.3% compared with 31.0%.

Forecasts of employment and population change between 1970 and 1990 for the area immediately surrounding the route segment indicate an employment growth of 21% and population growth of 10%. Most of the employment growth will be a continuation of office development along Market Street and completion of the Embarcadero Center Redevelopment Project. The residential growth will involve the completion of the Golden Gateway Redevelopment Project and the residential complex at the far north portion of the segment near Lombard Street adjacent to Telegraph Hill.

f. Impacts

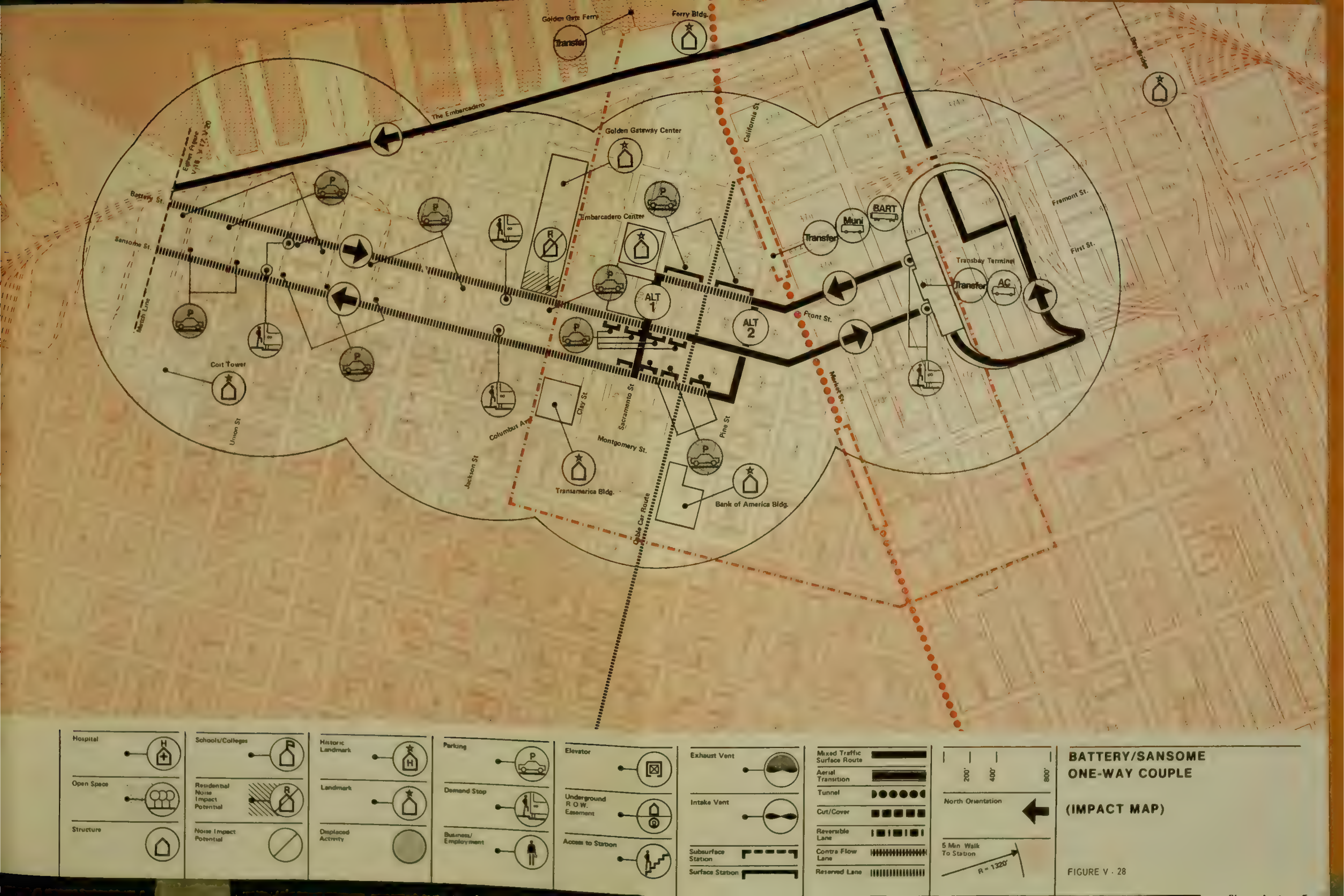
Impacts from the Battery/Sansome Streets reserve lane and loading shelters are graphically shown in Figure V-28.

1) Displacement

Buses operating in reserved right lanes will cause 87 parking spaces to be displaced on Battery and Sansome Streets during the a.m. and p.m. peak period respectively. Since very little of Battery and Sansome Street frontage is utilized by auto-oriented retail establishments, the loss of parking will probably not adversely affect business activity. Many of these spaces are currently located in peak-hour tow away zones.

2) Visual

The visual changes to Battery and Sansome Streets have been graphically illustrated in Figure V-22. This figure also indicates the urban design treatment of the major Financial District morning unloading areas. The principal visual change would be the additions of the bus shelters at the Financial District loading area. The architectural treatment of these shelters has been discussed previously and illustrated in Figures V-23, V-25 and V-26. The shelters may present an adverse visual impact to adjacent retail establishments whose businesses may be partially obscured from street view by the shelters even though care was taken to design the shelters to be as transparent as possible.



BATTERY/SANSOME
ONE-WAY COUPLE

(IMPACT MAP)

FIGURE V · 28

3) Joint Development

Opportunities exist for joint development of bus shelters with adjacent new buildings, thus eliminating the need for a separate bus shelter. First floor spaces could be developed for joint use passenger loadway areas.

Joint development opportunities also exist in the illustrated bus shelter concept which encourages entrepreneurs to utilize kiosk areas between loading zones for transit-serving convenience commercial establishments.

4) Land Use

Employment forecasts indicate a demand for over 10 million square feet of new office space in the area of the Financial District that is within a 5-minute walking distance to the Golden Gates bus stops. Currently underutilized parcels in the same area afford over 40 million square feet of allowable floor area under current zoning regulations, 4 times the 1990 demand requirement.

The attraction of auto users to the improved single surface routes would eliminate the need for approximately 900 future parking spaces in the Financial District in 1990. This number of spaces occupies six acres of land which can be converted into uses more productive than parking.

5. FACT SHEET

Eight single surface route alternatives can be identified by combining the various preferential bus treatments and alignments for each route segment described above.

The eight alternatives include the following combinations of improvements:

	ALTERNATIVES							
IMPROVEMENTS	S1	S2	S3	S4	S5	S6	S7	S8
Lombard-Reserve Lane	X	X	X	X				
-Contraflow Lane					X	X	X	X
Van Ness-Reserve Lane	X	X			X	X		
-Underpass			X				X	
N. Pt.-Reversible Lane		X	X			X	X	
-One Way Couple	X				X			
Embarcadero Reserve Lane	X	X	X		X	X	X	
Lombard Tunnel				X				X
Battery/Sansome Reserve Lane	X	X	X	X	X	X	X	X

Data summarizing these eight alternatives are shown on the table on the following page. The data on the table are based on the general assumptions and factors described in Section VA, and the description and analysis presented throughout Section VB.

SINGLE SURFACE ROUTES FACT SHEET
(1990 Conditions)

Item	EXISTING SYSTEM	SINGLE SURFACE ROUTES							
		Lombard Reserve Lane				Lombard Contraflow Lane			
		N. Pt./Bay (S1)	N. Pt. (S2)	Underpass (S3)	Tunnel (S4)	N. Pt./Bay (S1)	N. Pt. (S2)	Underpass (S3)	Tunnel (S4)
Travel Time. From Toll Plaza to Financial District Station in minutes	28.6	16.6	16.6	15.5	12.5	16.6	16.6	15.2	12.5
Patronage. 1990 one-way, peak period									
-Bus riders	11,700	12,800	12,800	12,900	13,000	12,800	12,800	12,900	13,000
-Number of buses to financial district	97	110	110	112	113	110	110	112	113
-Total number of buses	147	160	160	162	163	160	160	162	163
-Auto reduction	0	850	850	920	1,000	850	850	920	1,000
Accessibility. Number of people within 5 minute walk of service in San Francisco									
-Employees	282,000	282,250	273,450	270,000	270,000	282,250	273,450	270,000	270,000
-Residents	75,000	77,500	69,900	62,500	62,500	77,500	69,900	62,500	62,500
-Transit dependents	31,000	31,200	28,450	26,100	26,100	31,200	28,450	26,100	26,100
Short Term Impacts.									
-Construction disruption	None	Slight	Slight	Moderate	Moderate	Slight	Slight	Moderate	Moderate
-Construction employment in person-years	None	25	27	130	400	24	25	130	400
Long Term Impacts									
-Number of dwelling units along route	4,881	5,405	4,365	4,320	3,634	5,405	4,365	4,320	3,634
-Air pollutants (percent reduction)	None	1.5	1.5	1.6	1.8	1.5	1.5	1.6	1.8
-Fuel consumed*	142,500	-2,200	-2,200	-2,400	-2,600	-2,200	-2,200	-2,400	-2,600
-Traffic conflicts	Severe	Severe	Severe	Moderate	Moderate	Moderate	Moderate	Slight	Slight
Displacement.									
-Number of employees		None	None	None	5	None	None	None	5
-Number of businesses		None	None	None	1	None	None	None	1
-Number of parking spaces		223	172	174	174	151	100	102	102
Service Life. Approximate year congestion will degrade service below current level	1975	1985-1990	1985-1990	After 1990	After 1995	1985-1990	1985-1990	After 1990	After 1995
Cost Data. (1975 dollars)									
-Capital cost		1,556,000	1,652,000	7,990,000	24,614,000	1,451,000	1,548,000	7,885,000	24,509,000
-Operating cost	3,700,000	3,300,000	3,300,000	3,200,000	3,100,000	3,400,000	3,400,000	3,300,000	3,100,000
-Annual $ benefits derived		2,490,000	2,460,000	2,628,000	2,898,000	2,450,000	2,420,000	2,588,000	2,858,000
-Incremental benefit/cost ratio		14.56	13.5	5.69	2.44	15.41	14.24	5.75	2.43

* Gallons of fuel used per day by buses and autos

C. SUBSURFACE ROUTES

Two alternatives for the subsurface route concept were selected in Section IV for detailed study. They are the Kearny Street alignment and the Battery Street alignment which vary only in their downtown alignment and station locations.

Some of the environmental impact material contained in the following description of the subsurface routes was partially provided by the planning and environmental consulting firm EDAW, Inc.

1. Route Descriptions

The two alternatives are two-lane subsurface routes extending from Doyle Drive in The Presidio to the Transbay Terminal. Both routes would be 4.8 miles in length. Details of the plan, profile and sections of the routes are shown in Figures V-29 through V-36. The alignment and rights-of-way of both routes satisfy the system criteria for possible future conversion from bus system operation to a fixed guideway system.

Both routes would begin just west of the junction of Doyle Drive and Richardson Avenue. The eastbound bus lane would diverge from the Doyle Drive aerial structure and descend at an 8% grade to a cut-and-cover configuration crossing underneath Halleck Street, Marshall Street, and Gorgas Avenue. The southbound lane would then curve south in retained cut configuration and converge with the westbound bus lane. From this point the westbound bus lane would proceed in a northwesterly direction, cross underneath Doyle Drive in a retained cut, curve to the west crossing underneath Marshall Street, and ascend at a 10% grade to join the Doyle Drive aerial roadway in the westbound direction. From the point of convergence of the eastbound and westbound bus lanes, the two-lane route would continue southeast in retained cut along Richardson Avenue to a tunnel portal located within the Presidio opposite the Palace of Fine Arts. A station would be provided in retained cut to the north of the tunnel portal. Proceeding south from the tunnel portal, the route would turn southeast under Richardson Avenue and then turn east underneath Lombard Street in twin-tube, bored tunnels. A ventilation fan shaft and drainage pumping station would be located at the bottom of a gentle downgrade at Pierce Street. From there the route would ascend at a 1.4% grade to a station located between Franklin Street and

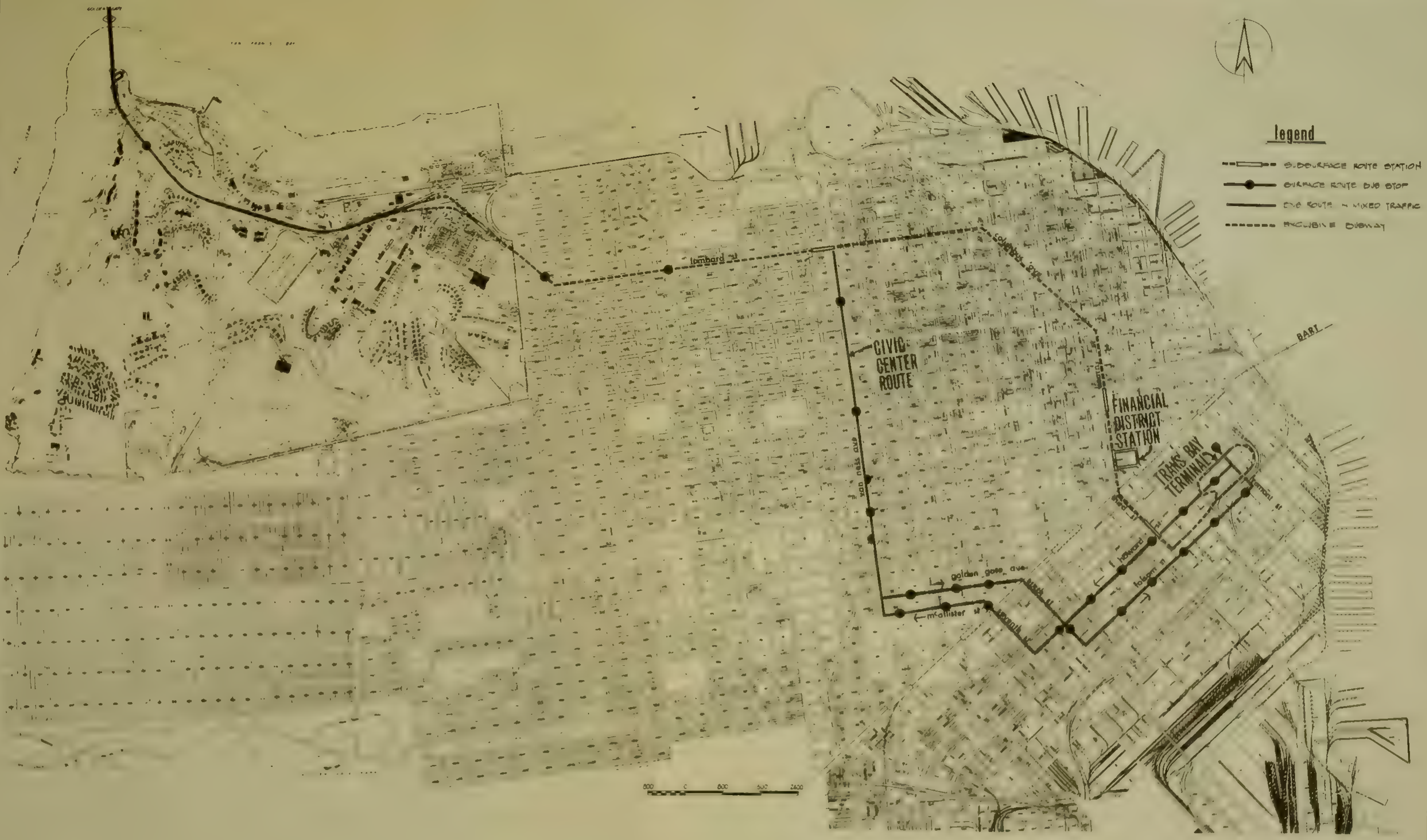


FIGURE V 29

SINGLE SUBSURFACE ROUTE SYSTEM
LOMBARD - COLUMBUS - KEARNY

KAISER ENGINEERS

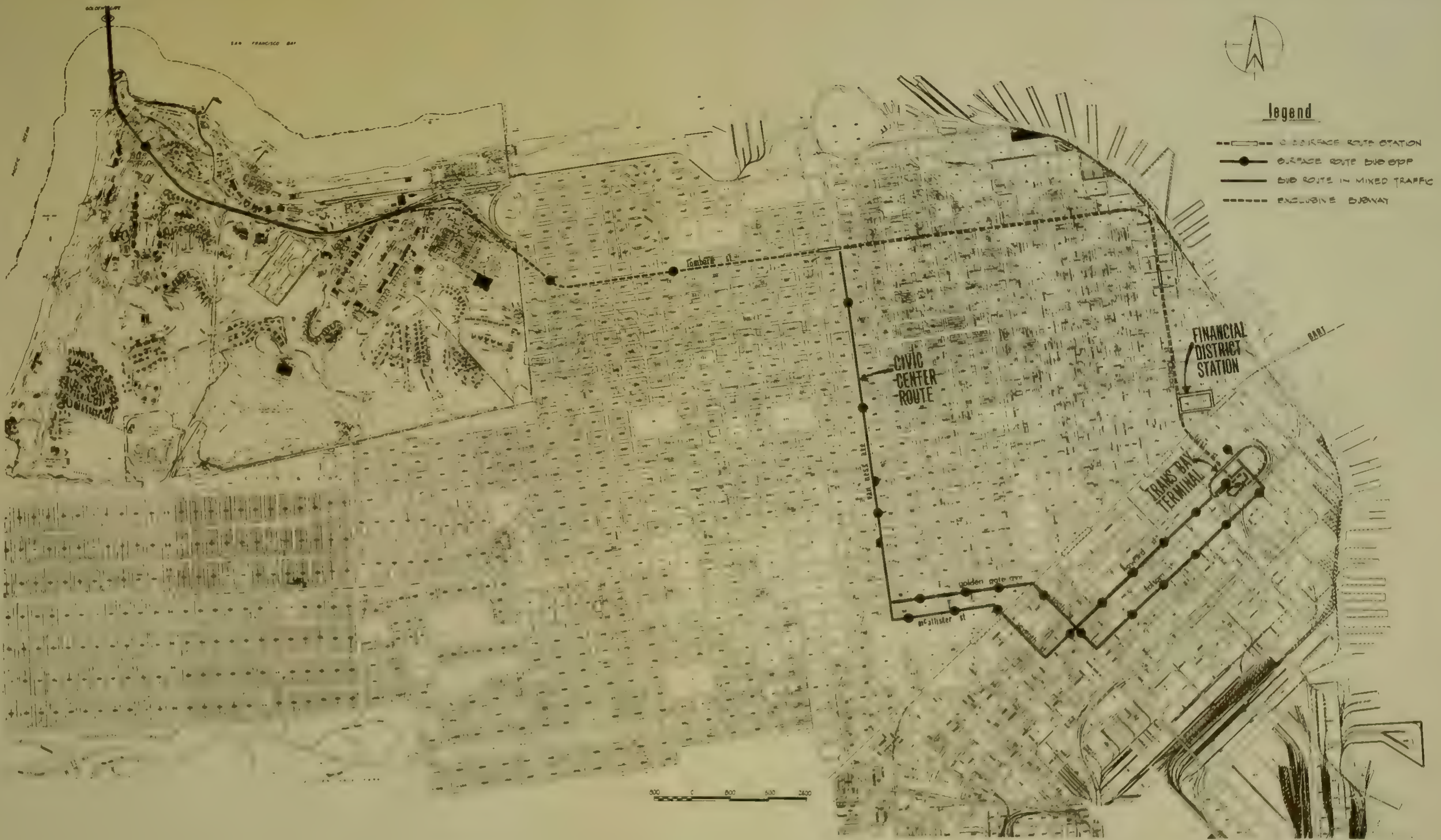


FIGURE V-30

SINGLE SUBSURFACE ROUTE SYSTEM
LOMBARD - BATTERY

KAISER ENGINEERS

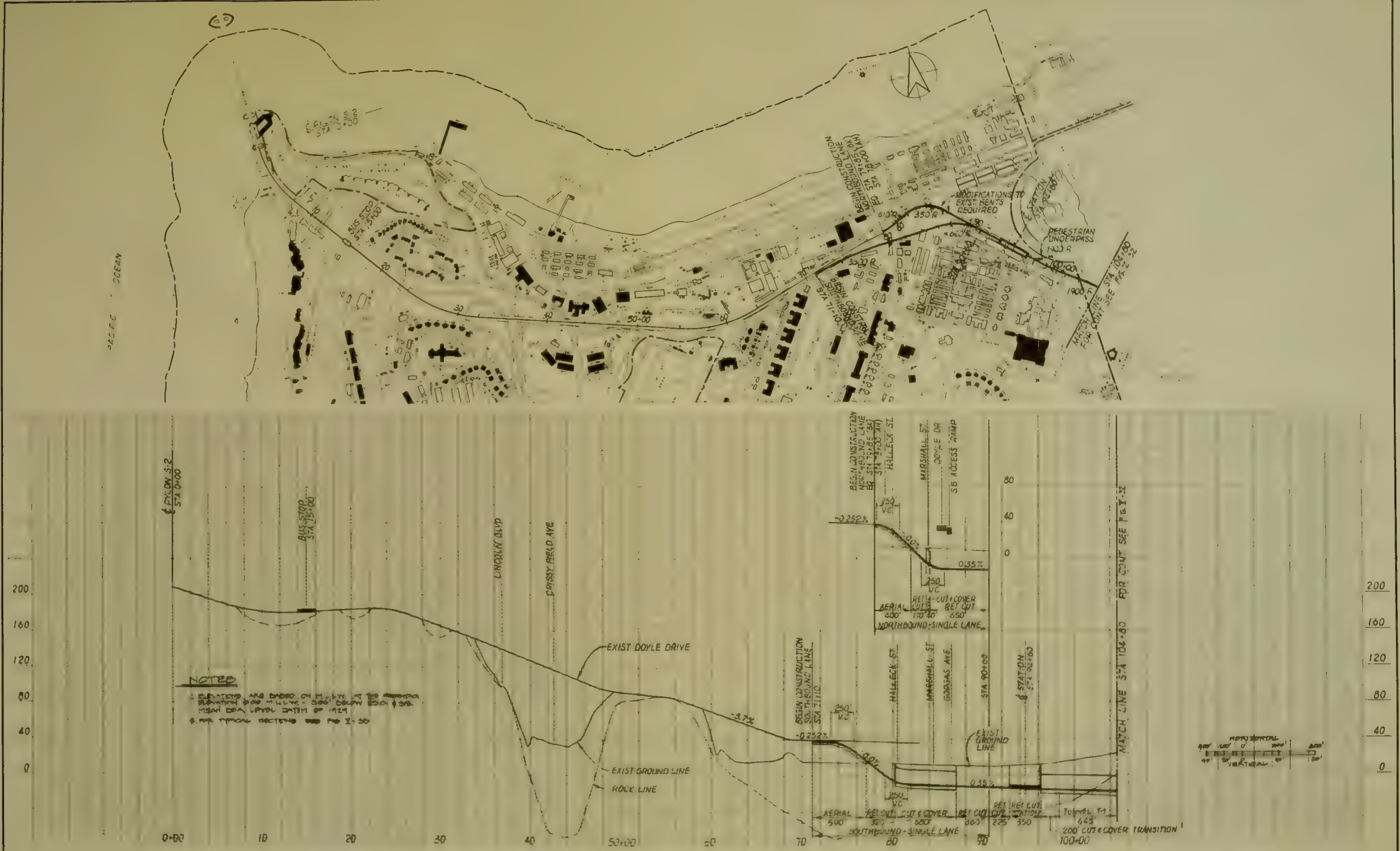


FIGURE V 31

SINGLE SUBSURFACE ROUTE SYSTEM
PLAN AND PROFILE - DOYLE DRIVE

KAISER ENGINEERS

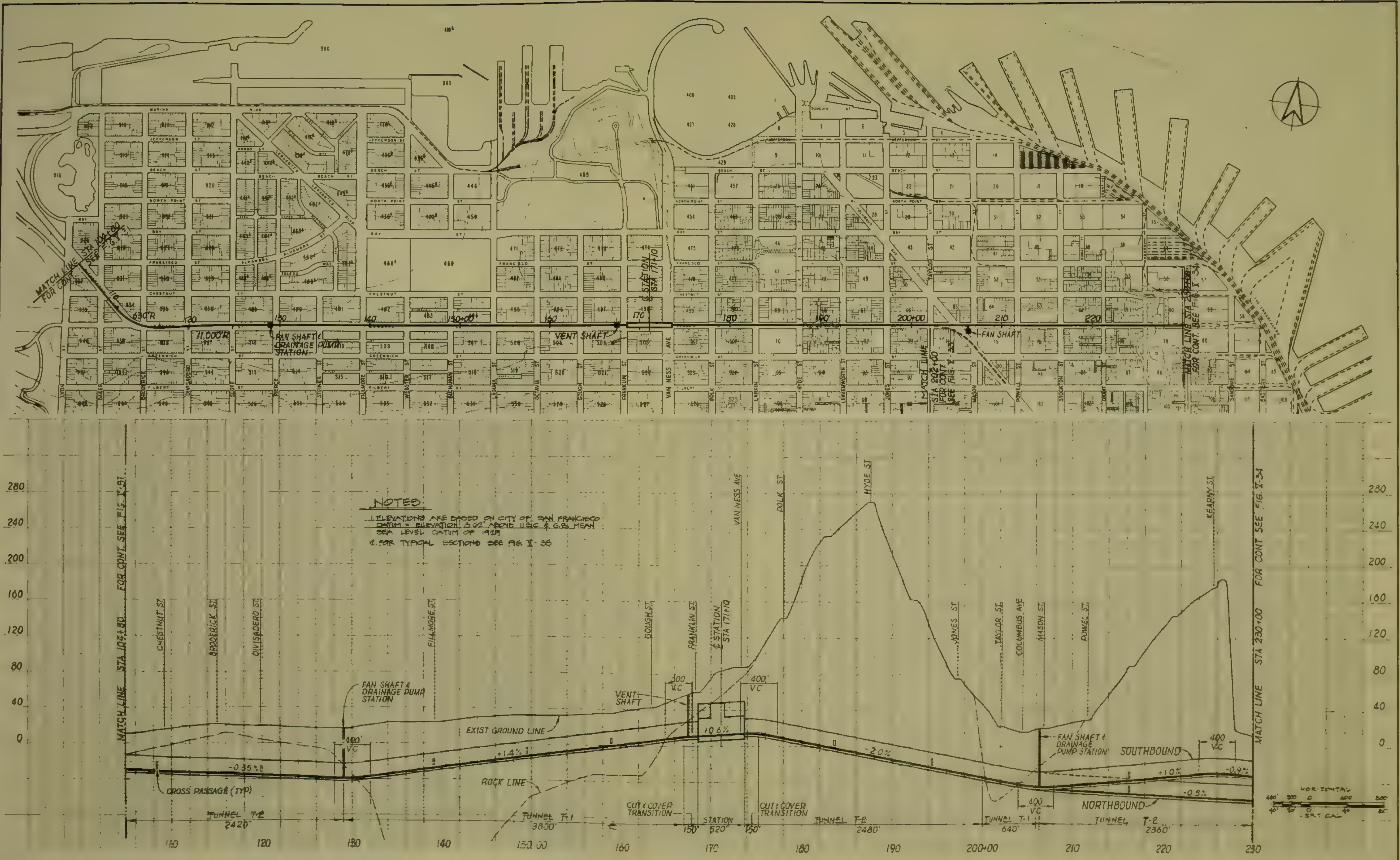
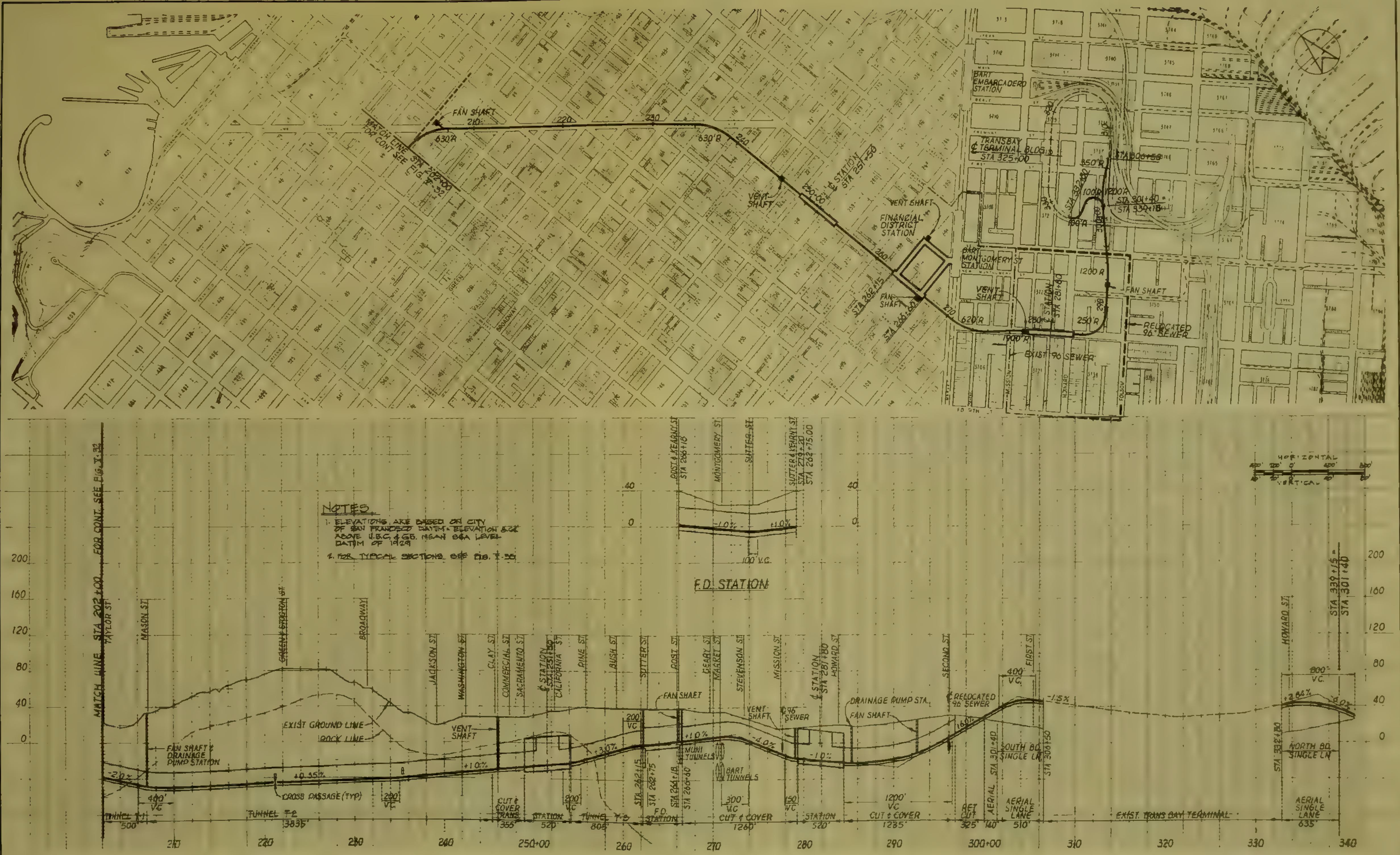


FIGURE V 32

SINGLE SUBSURFACE ROUTE SYSTEM PLAN AND PROFILE - LOMBARD STREET

KAISER ENGINEERS



NOTES.

1. ELEVATIONS ARE BASED ON CITY OF SAN FRANCISCO DATUM. ELEVATION 8.62 ABOVE U.S.C.&G.S. MEAN SEA LEVEL DATUM OF 1929

2. FOR TYPICAL SECTIONS SEE FIG. V-35

FIGURE V 33

SINGLE SUBSURFACE ROUTE SYSTEM
PLAN AND PROFILE - COLUMBUS - KEARNY

KAISER ENGINEERS

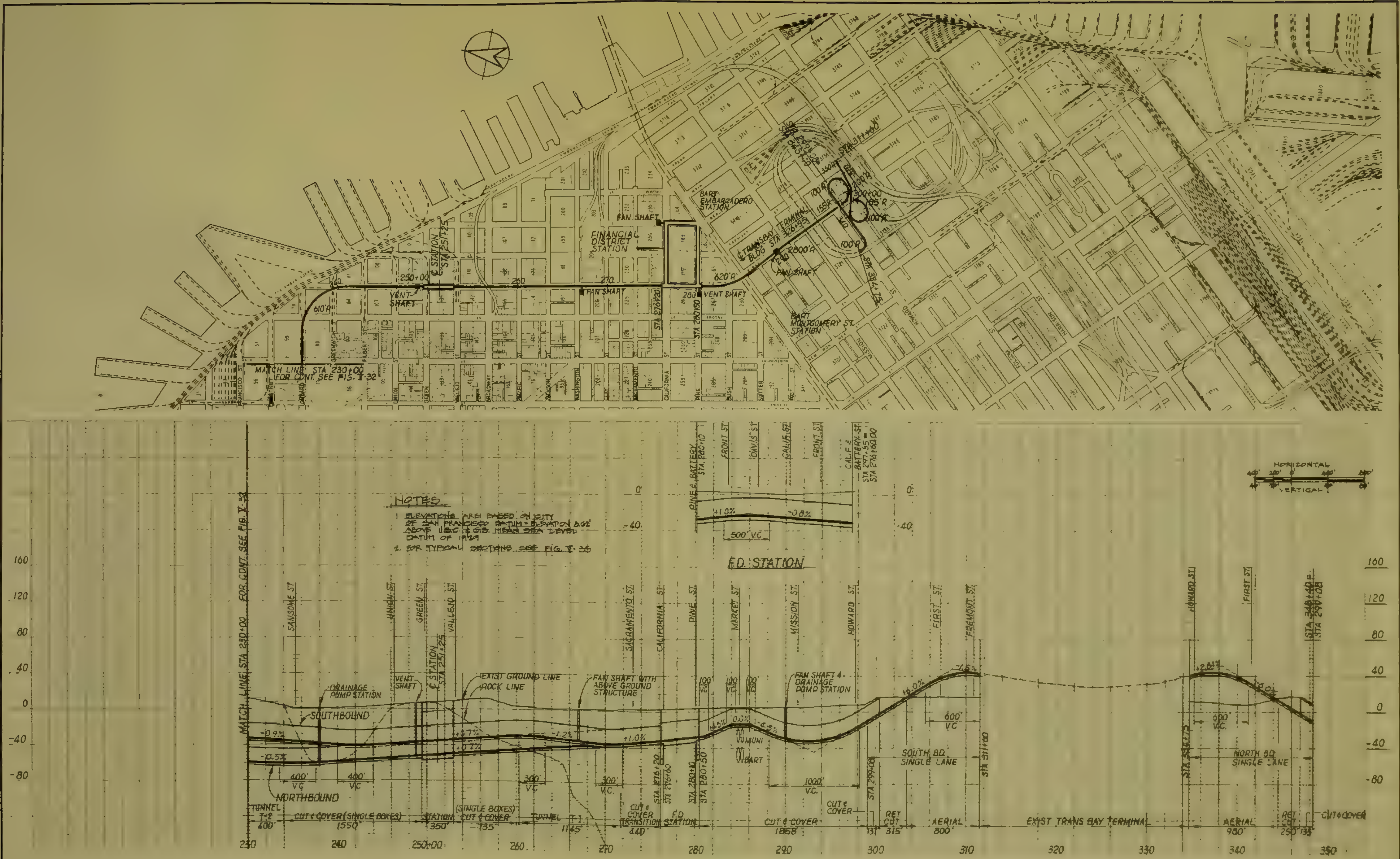
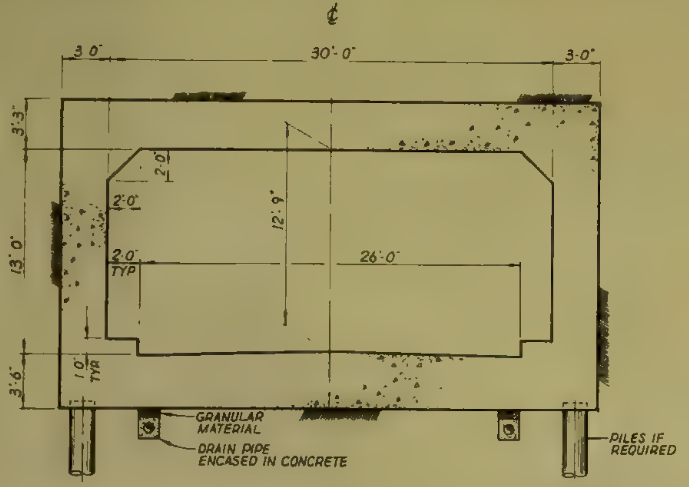


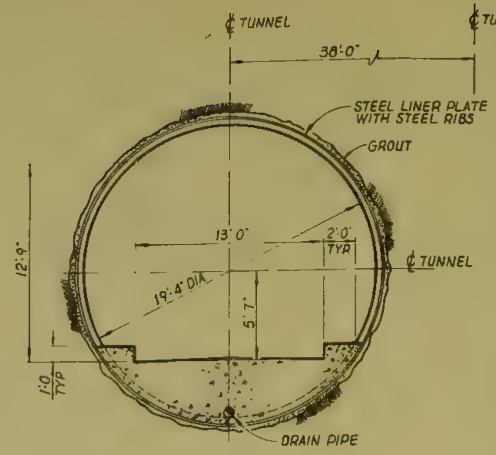
FIGURE V 34

SINGLE SUBSURFACE ROUTE SYSTEM
PLAN AND PROFILE-BATTERY STREET

KAISER ENGINEERS

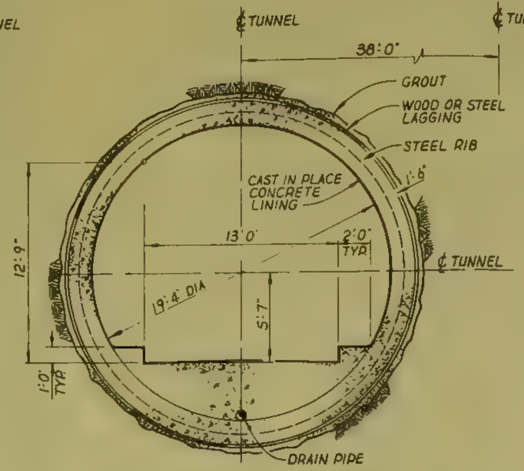


CUT & COVER



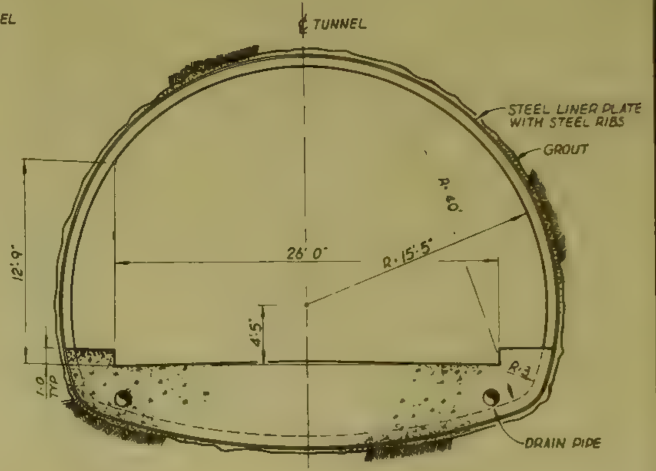
TUNNEL TYPE·T1

SINGLE LANE TUNNELS IN SOFT GROUND



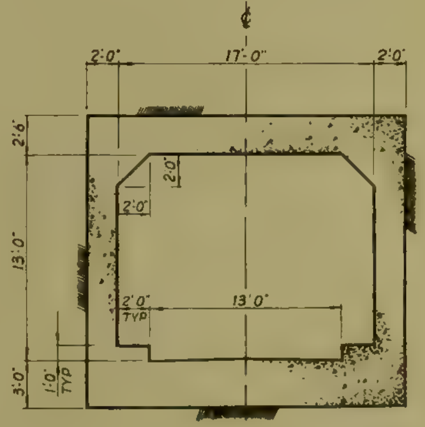
TUNNEL TYPE·T2

SINGLE LANE TUNNELS IN ROCK

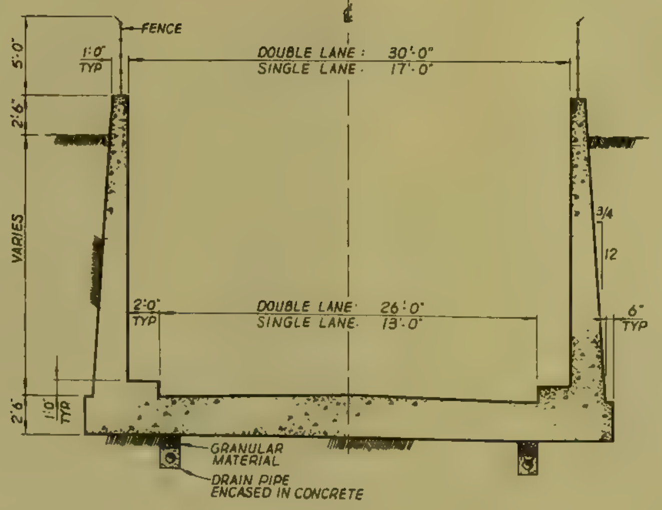


TUNNEL TYPE·T3

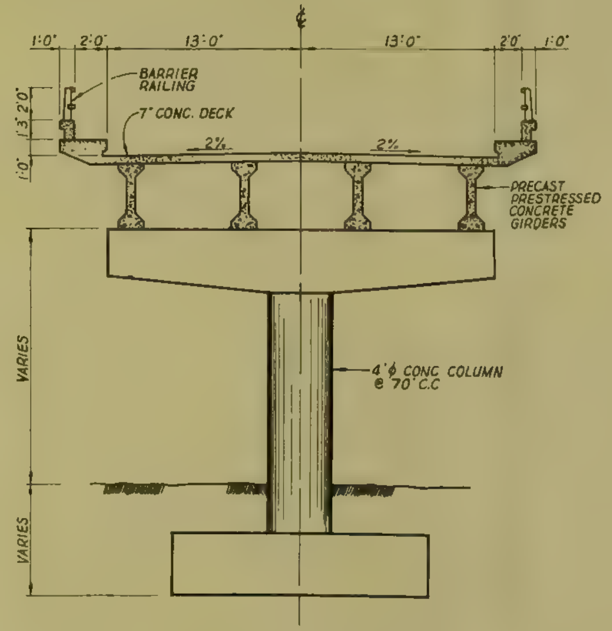
TWO LANE TUNNEL IN SOFT GROUND



CUT & COVER·SINGLE BOX



RETAINED CUT

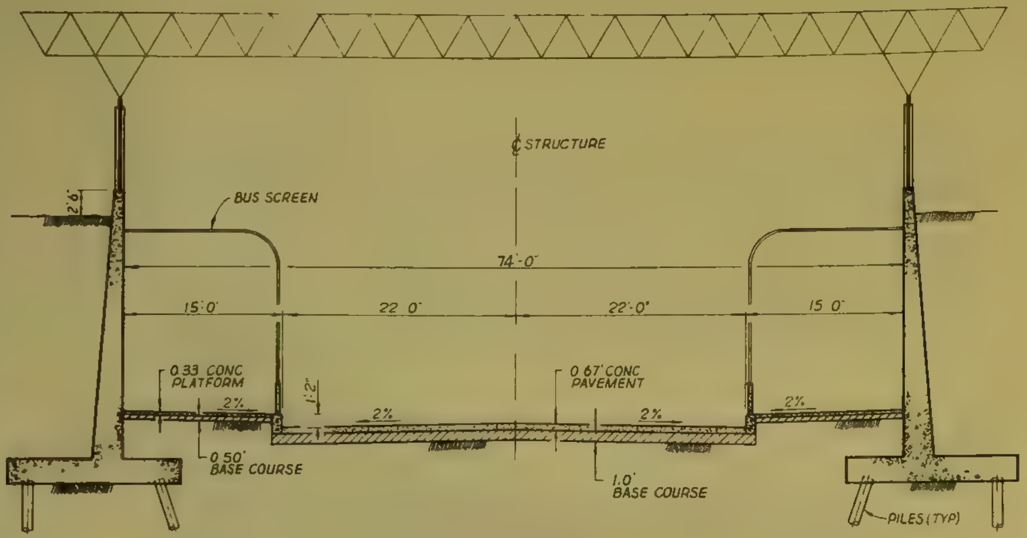


AERIAL

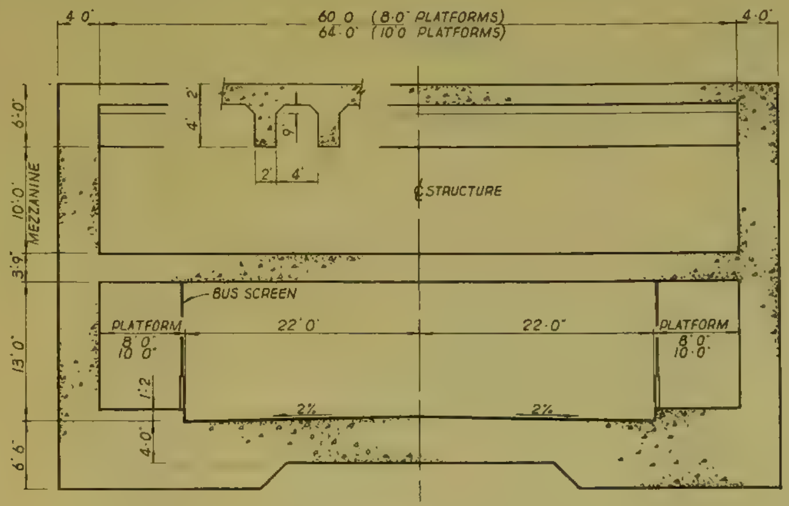
FIGURE V-35

TYPICAL SECTIONS

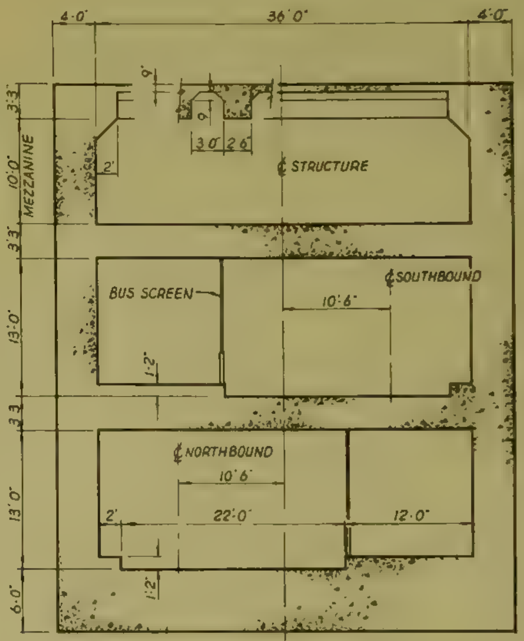
KAISER ENGINEERS



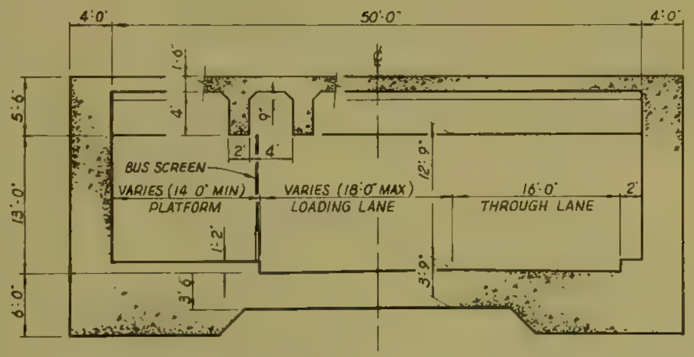
PRESIDIO STATION



SUBWAY STATION



BATTERY/GREEN STATION



FINANCIAL DISTRICT STATION

FIGURE V-36

TYPICAL SECTIONS

KAISER ENGINEERS

Van Ness Avenue. The subsurface Van Ness Avenue station and a ventilation shaft on the west side would be constructrd using the cut-and-cover method with temporary street decking to maintain traffic during construction. Proceeding east from the Van Ness Avenue station, the busway would continue straight through Russian Hill in two single-lane bored tunnels descending on a 2% grade to Columbus Avenue. At this point the alignment of the two alternatives would diverge.

a. Kearny Street Alignment

From the alignment under Lombard Street at Columbus Avenue, the Kearny Street alternative turns southeast and continues under Columbus Avenue to Kearny Street. A ventilation fan shaft and drainage pumping station would be provided at the bottom of a 2% downgrade at Columbus Avenue and Lombard Street. From there the route would ascend on a 0.35% grade to Kearny Street. The route would enter Kearny Street and proceed south in twin-tube, bored tunnels to Clay Street. Cut-and-cover construction techniques with temporary street decking would be employed between Clay Street and mid-block between California and Pine Streets. A ventilation shaft would be located at Clay Street and a side-platform station at California Street.

From the California Street station, the route would ascend at a 3% gradient and continue south under Kearny Street in a two-lane bored tunnel to the main Financial District station. This station would be arranged in a loop configuration underneath Kearny, Post, Montgomery, and Sutter Streets. It would be constructed with the cut-and-cover method. From the Financial District Station, the route would proceed south under Kearny Street ascending on a 1% grade and cross over the MUNI/BART subway tunnels under Market Street. The route then would descend on a 4% grade and turn southeast to Third Street. The existing 96-inch diameter sewer in Mission Street would be in conflict with the route and would have to be relocated. A subway station would be provided at Third Street between Minna and Howard Streets. Just south of the Third Street station, the route would turn sharply to the northeast to a location under Clementina Street. Proceeding northeast under Clementina Street, the route would ascend on a 6% grade and cross underneath Second Street to a tunnel portal located just northeast of Second Street.

A ventilation fan shaft would be located at Hawthorne Street. The subway portion from the Financial District station to the tunnel portal would be constructed utilizing cut-and-cover techniques with temporary street decking for maintaining traffic.

The connection to and configuration of the Golden Gate bus terminal at the Transbay Terminal would depend on decisions concerning the Transbay Terminal. The following route alignment assumes that the Terminal would remain in its present configuration.

Proceeding northeast from the tunnel portal, the route would continue to ascend on a 6% grade to aerial configuration to join the Transbay Terminal aerial busloop. The southbound and northbound lanes would diverge and connect to the inside of the busloop such that the existing one-way bus traffic flow in a counterclockwise direction would be maintained.

The geometry of the Lombard-Columbus-Kearny subsurface route is suitable for possible conversion to a fixed guideway system from The Presidio station to and including the Third Street station. The Financial District fixed guideway station would be located under Kearny Street and the loop extending under Post, Montgomery, and Sutter Streets would then be made available for station access and other uses.

b. Battery Street Alignment

Proceeding east from the Columbus Avenue and Lombard Street intersection, the Battery Street alternative would continue straight under Lombard Street through Telegraph Hill in two single-lane bored tunnels. After crossing under Columbus Avenue, the tunnel would change from a side-by-side to a stacked configuration with the southbound tunnel located on top of the northbound tunnel. The route would continue east in a stacked configuration, turn into Battery Street, and then proceed south to a two-level station located between Green and Vallejo Streets. The southbound platform would be on the upper level and the northbound platform on the lower level. The width of Battery Street is insufficient for a station on one level.

A drainage pumping station would be located at a low point in the tunnels east of Sansome Street. From here the route would

ascend on a 0.7% grade through the Green Street Station. Cut-and-cover construction techniques with temporary street decking for traffic would be employed through the curve at Battery Street and south under Battery Street to Pacific Street.

Proceeding south under Battery Street from the Green Street station, the two tunnels would return to a side-by-side configuration. The vertical transition which occurs between Pacific and Sacramento Streets would be constructed using bored tunnel techniques. A ventilation fan shaft would be provided at Washington Street. At California Street the twin tunnels would merge into a two-lane structure. Cut-and-cover construction methods would be used in this transition between Sacramento and California Streets.

The Financial District station would be a loop underneath Battery, Pine, Davis, and California Streets. Cut-and-cover construction methods with temporary street decking would be used for this station. From the Financial District station, the route would proceed south under Battery Street ascending on a 4.5% grade to cross over the MUNI/BART tunnels under Market Street, and then descend on a 4.5% grade curving to underneath First Street. Proceeding southeast under First Street, the route would continue to descend on a 4.5% grade to a low point at Mission Street, then ascend on a 6% grade and cross underneath the Transbay Terminal and Howard Street. A ventilation fan shaft and drainage pumping station would be provided at Mission Street.

The configuration of the route terminus at the Transbay Terminal would depend on the future decisions concerning this terminal. The following route description is one possible solution if the Terminal remained in its present configuration.

After crossing under Howard Street, the southbound and northbound lanes would diverge, turning in full circles (100 feet to 200feet radii) spiraling up at a 6% grade. The eastbound tunnel portal would be southwest of First Street and the northbound portal would be northeast of First Street. The lanes would ascend via aerial configuration and join the inside of the Transbay Terminal busloop such that the existing one-way bus traffic flow in a counterclockwise direction would be maintained.

The geometry of the Lombard-Battery subsurface alignment also is suitable for possible conversion to a fixed guideway system from a point just north of the Presidio station to Market Street. The vertical profile of the route at the Market Street crossing does not meet rail fixed guideway system criteria. An undercrossing of the MUNI/BART tunnels would place the Financial District Station at unreasonable depth. The Financial District fixed guideway station located under Battery Street would then become the terminal station. The loop extending under Pine, Davis, and California Streets could then be made available for station access and other uses. Another alternative would be to design the station without a mezzanine so that the grade across Market Street would allow a possible future rail fixed guideway system extension across Market.

2. Stations

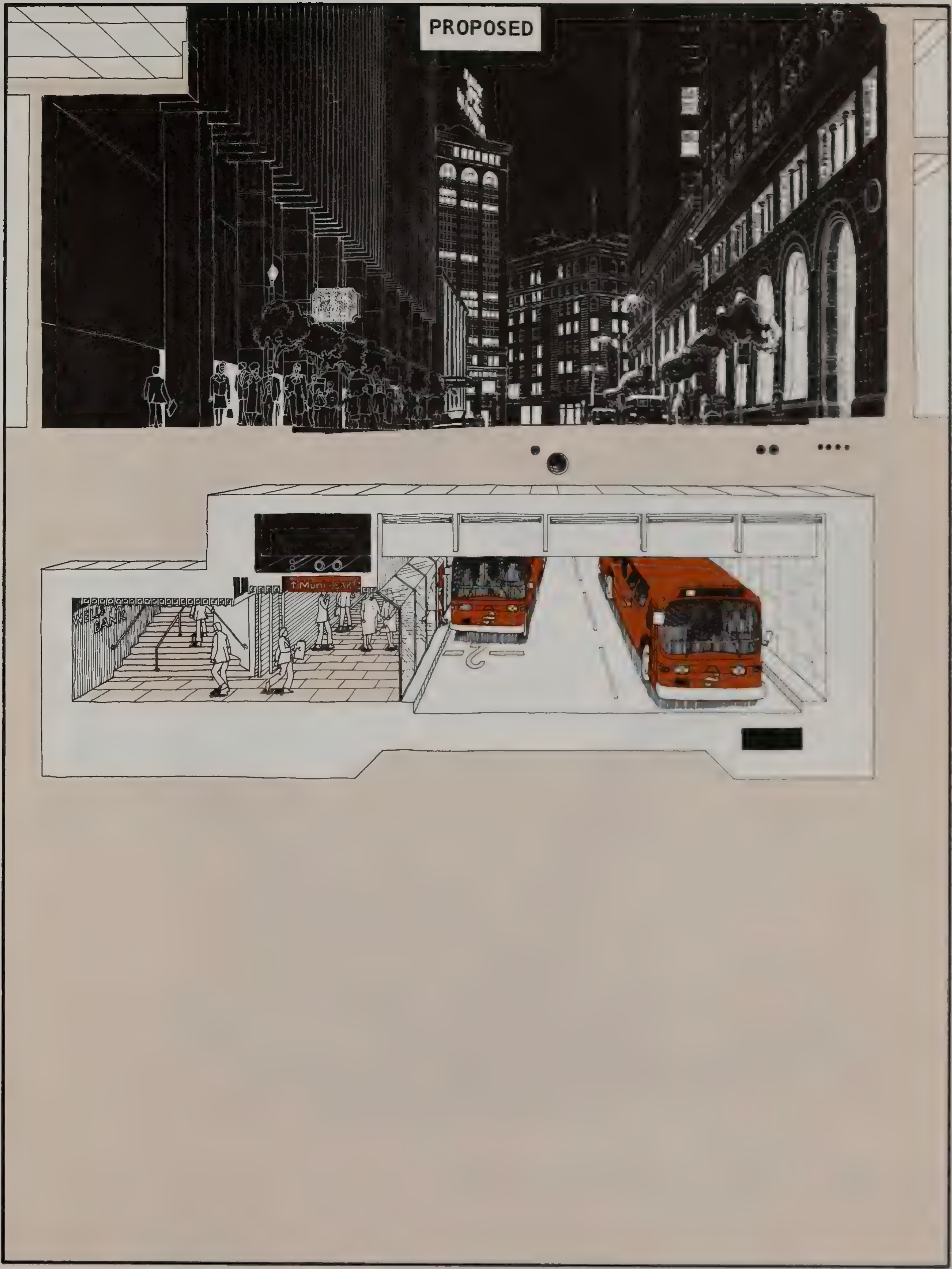
Conceptual architectural designs were prepared for the Financial District and intermediate stations of both alternatives. These designs are illustrative of just one approach to final design and do not preclude other design solutions. These designs are used to demonstrate the functional organization of the stations, to indicate urban design problems and opportunities involved in retrofitting the station into the existing areas, and to be the basis for cost estimates.

a. Financial District Stations

The Financial District is the primary origin and destination of the Golden Gate transit patronage. Financial District Stations would be considerably larger than typical intermediate stations. Stations for both alternatives would be a similar configuration consisting of an underground, one-directional loop off the main busway. The Financial District Station for the Battery Street alternative would be located under Battery, Pine, Davis, and California Streets. The facility for the Kearny Street alternative would be below Kearny, Post, Montgomery and Sutter Streets. Design concepts prepared for each alternative are illustrated in Figures V-37 through V-39.

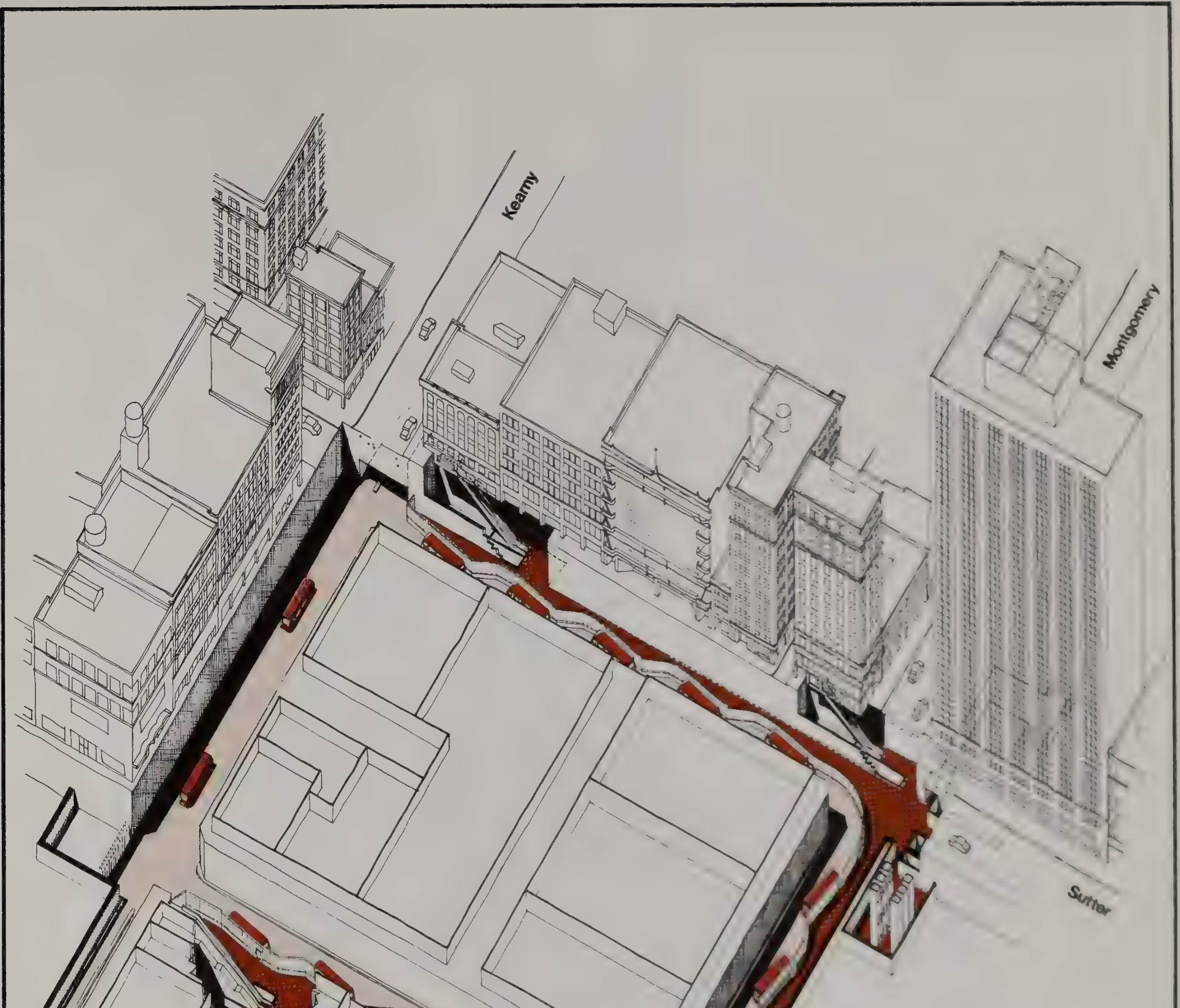
1) Passenger Circulation

The Battery Street station has a direct pedestrian passageway

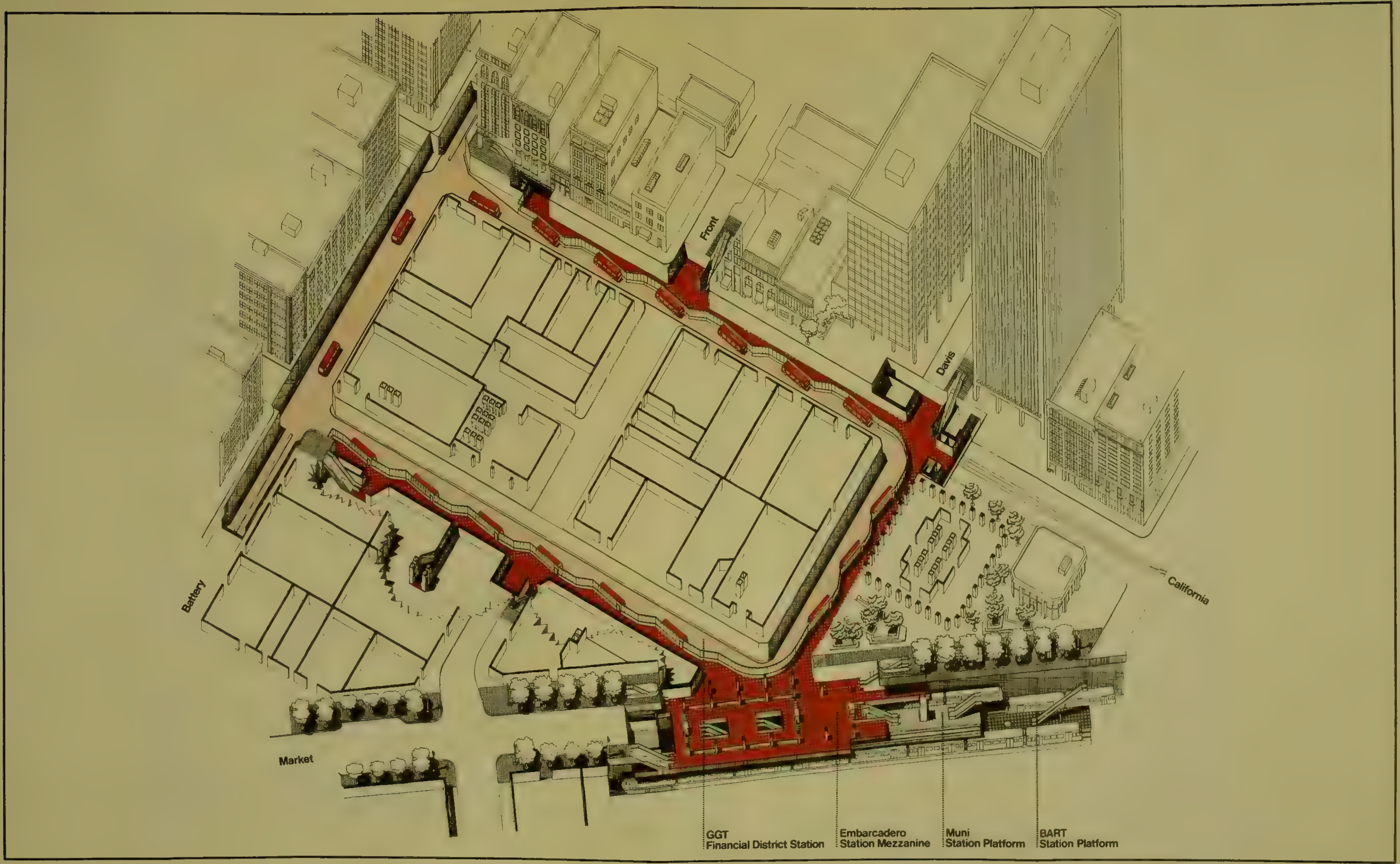


FINANCIAL DISTRICT STATION - KEARNY STREET

FIGURE V-37



FINANCIAL DISTRICT STATION - KEARNY STREET



FINANCIAL DISTRICT STATION - BATTERY STREET

to the mezzanine level of BART's Embarcadero Station and the Montgomery Street Station has a direct connection to BART's Montgomery Street Station. This connection would offer Golden Gate Transit passengers easy transfer opportunity to both BART and MUNI transportation. The Financial District stations could share BART's elevator for the handicapped patron.

Entrances to the Financial District stations would be provided at street intersections immediately above the station platform. Entrances would be generally located on widened sidewalks or on private property. In the latter case, the entrance would require a portion of the first floor, lobby, or plaza of a private building to accommodate stairs and escalators to the bus station. The City of San Francisco encourages developers of new construction in the Financial District to provide direct access to regional transit stations by offering to increase the allowable building area up to an additional 20%. Many new buildings have taken advantage of this development bonus by providing direct access to the BART stations.

2) Amenity and Environmental Control

The Financial District stations have been designed to provide a high level of amenity for transit passengers. The general ambience of the station is envisioned to be much like rail rapid transit stations such as BART's.

Space would be provided in the Financial District station for passenger convenience facilities including commercial concession kiosks, restrooms, ticket purchasing facilities, public telephones, and an information booth. The Financial District station also would have a control room for the dispatch agent. Graphics would communicate to the passengers information concerning bus schedules and loading areas.

Passenger and busway portions of the stations would be separated by a transparent bus screen to isolate bus-generated noise and air pollution from the passenger spaces. Passenger and bus areas of the station would be ventilated by two separate ventilation systems to maintain high air quality in the passenger areas. Stations would be heated to provide for passenger comfort when necessary. The bus screen would protect passengers from drafts in the busway.

3) Security

Station lighting would be at a level to provide adequate security of patrons and of the station area. Levels would be set in accordance with local practice. Surveillance of the station would be provided by closed circuit TV with monitors located at the station control room.

4) Convertibility to Fixed Guideway

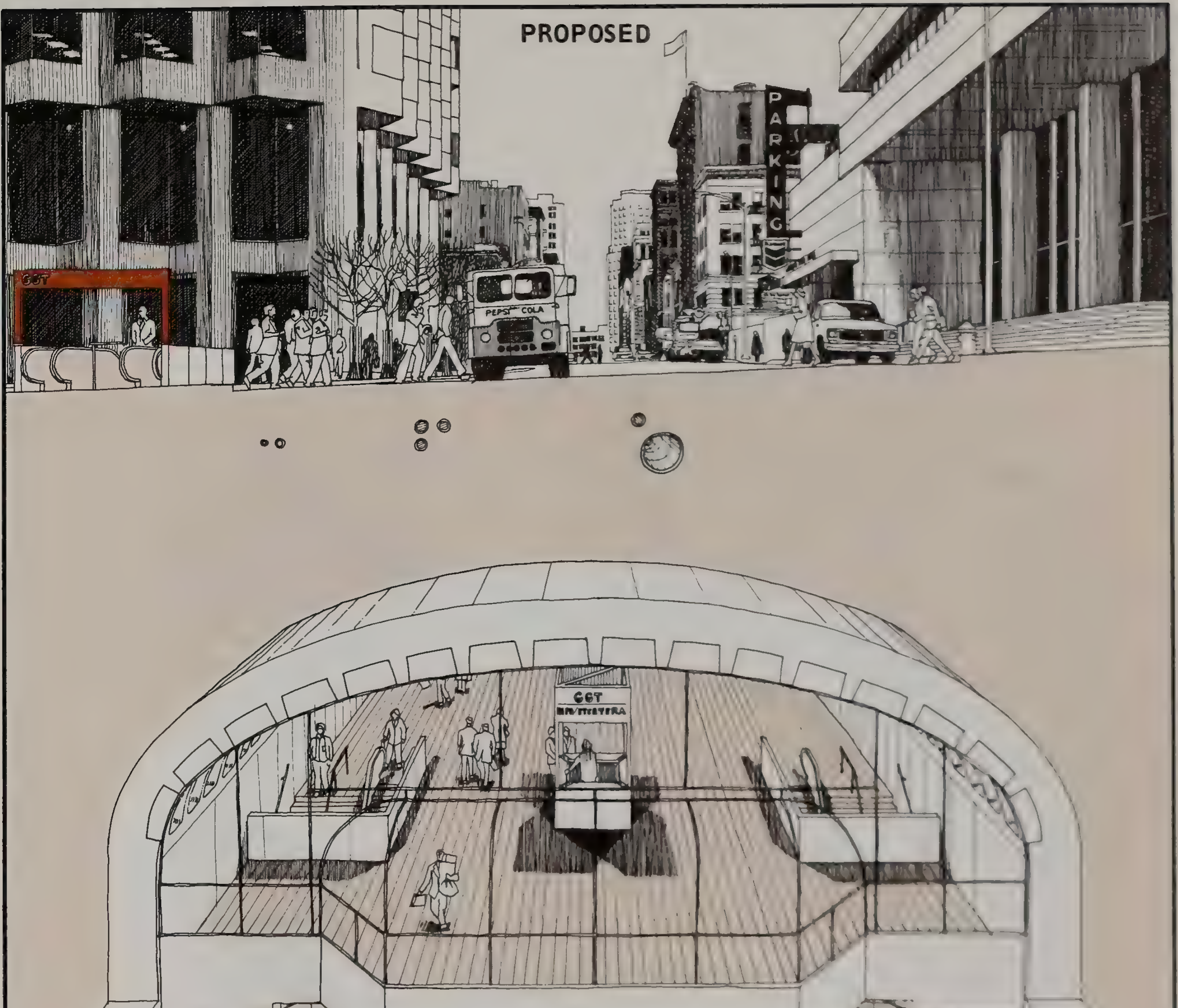
The Financial District Station is convertible to a BART-type rail rapid transit station. In the event of such a conversion, the Kearny or Battery Street portion of the Financial District Station would be retrofitted to be a side platform station. Ticketing and cross platform access would necessitate a mezzanine or underpass below the platform level. This feature would have to be provided for during initial construction and sealed until conversion took place. Upon completion of conversion, the remainder of the busway would be utilized for pedestrian access and ancillary uses.

b. Intermediate Stations

Intermediate stations are located along each of the two subsurface routes to provide access to areas and activities not served by the Financial District stations. Service to the intermediate stations is by demand only; that is, the bus would stop at these stations only if someone wants to board or alight.

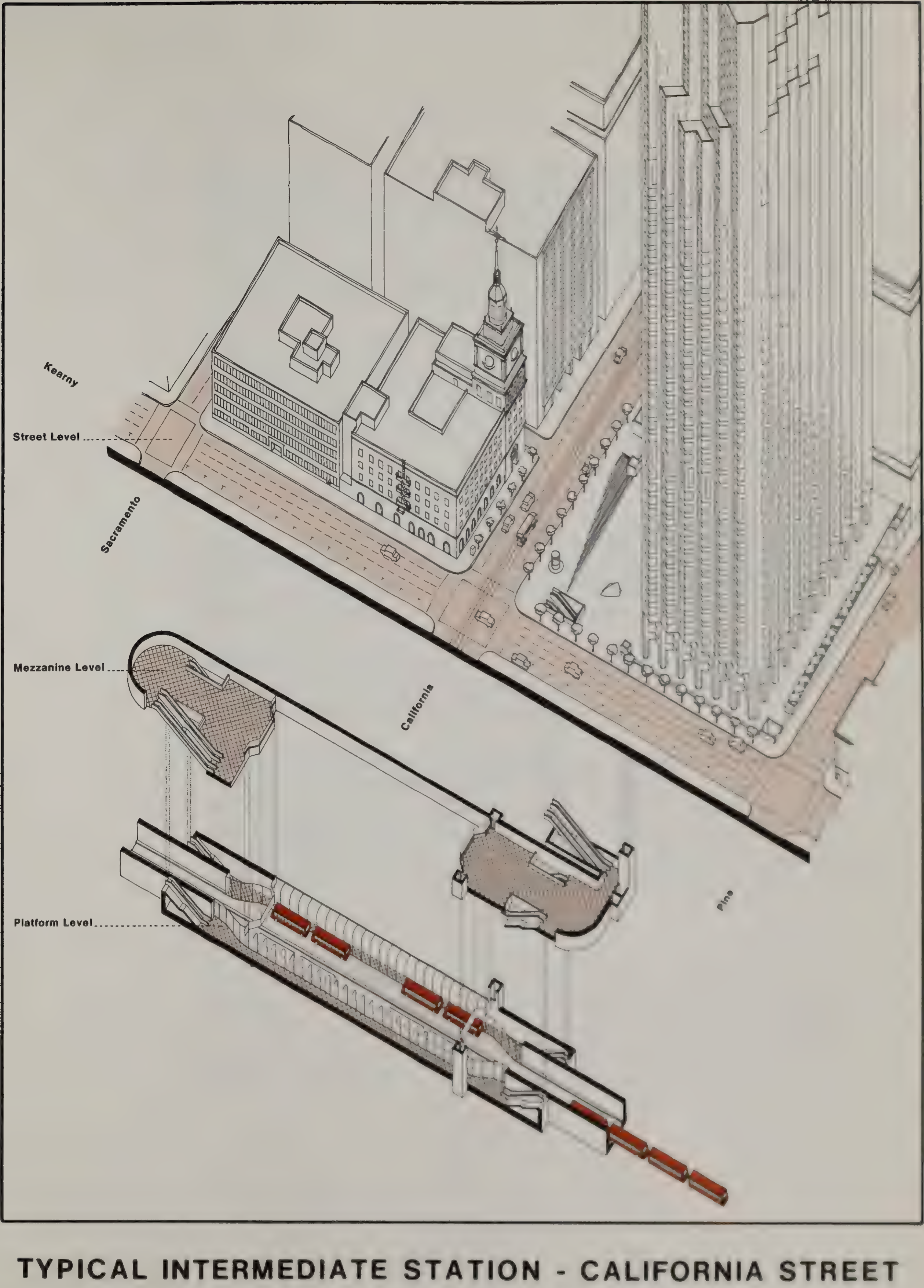
All intermediate stations feature a mezzanine level. Access to the platform level is gained from the mezzanine level. The busway is composed of four lanes, two through lanes, and two offline loading lanes. The off-line lanes are also used for deceleration and acceleration. Passengers board and exit the buses from two side platforms, one for each direction.

An architectural design concept was prepared for each station and the design for each station varies somewhat. The California Street station located on the Kearny Street subsurface alternative has been selected to demonstrate typical architectural treatment and urban design implications of intermediate stations and is illustrated in Figure V-40 and V-41.



TYPICAL INTERMEDIATE STATION
AT KEARNY AND CALIFORNIA

FIGURE V - 40



TYPICAL INTERMEDIATE STATION - CALIFORNIA STREET

FIGURE V - 41

1) Passenger Circulation

Station entrances would be located at the street level, generally on widened sidewalks or on private property. Each entrance would have at least one escalator and stairway, and an elevator would be provided for handicapped passengers. Knock-out panels are provided at the stations mezzanine level to accommodate entrances from adjacent private development.

The mezzanine level is spacious to allow for freedom of movement to platform levels. Passenger platforms vary in width; however, the minimum dimension is 7 feet 6 inches. This width is sufficient to accommodate passenger flow and queuing during peak periods.

2) Amenity and Environmental Control

Intermediate stations would have a high level of amenity and environmental control features. Stations would feature separate ventilation systems for both busway and passenger spaces to maintain high air quality conditions.

Passenger convenience facilities are provided at the mezzanine level including restrooms, an information booth, concession space, public telephones, etc.

The intermediate stations would have an interesting spatial two-story volume and vaulted roof structure. From the mezzanine level the passengers can look down to the platform level and experience the full activity of the station. Details of the station architectural form and finishes of the intermediate station at California Street are illustrated in Figure V-41.

3) Security

Intermediate stations would have facilities for a station attendant and closed circuit television. The intermediate station would have a unique security feature -- the station attendant would have direct visual surveillance of the loading platform from the information booth at the mezzanine level.

4) Convertibility to Fixed Guideway

Intermediate stations would be easily converted to fixed guideway stations by simple modifications to the platform level. Adequate space has been provided for the accommodation of ticketing facilities at the mezzanine level.

3. Service Considerations

The subsurface alternatives provide a higher level of service than those alternatives operating on the surface. The improvements create a more reliable system with quicker travel times, a smoother more comfortable ride, and high quality stations. However, the subsurface routes do have disadvantages concerning accessibility to the bus service.

Each of the subsurface routes would save about 19 minutes over mixed traffic bus operations in 1990. Not only is there a significant time savings but the reliability of the travel time would be much greater with the subsurface routes. Bus operations would not be subject to fluctuation in auto traffic conditions which may occur due to rainy weather, accidents, or special traffic generating events. The elimination of travel speed fluctuations and stops due to auto traffic will also provide a smoother, more comfortable ride for the passengers.

The high quality stations will provide the bus passengers with safe, weather-protected waiting areas as well as direct access into many office buildings. Directional signs, schedule information, a station agent, change machines, telephones, restrooms, and concessions will make the use of the bus system more convenient and easier to understand.

These improvement will result in substantial patronage increases over the mixed traffic surface operation. Patronage increases due to the improved service other than travel time could be as much as 10%. Based on the transportation model forecast (see Appendix VI) the 1990 one-way peak period patronage forecast for the subsurface routes is 14,700 for the Kearny Street alignment and 15,000 for the Battery Street alignment. The slight difference in patronage is due to the accessibility of the Financial District station.

The accessibility of workers to the Financial District station differs for the two alternatives. The average access time for the employment around the Financial District station is about 1.6 minutes faster to the Battery Street station than to the Kearny Street station. However, the Kearny Street alignment would better serve the Yerba Buena Redevelopment Project, if it is built.

Both the subsurface route alternatives provide poorer access to San Francisco residents than the surface alternatives. These routes require the residents to converge on the Financial District or intermediate stations in order to take advantage of the busway improvements. Thus the subsurface routes provide little improvement for reverse commuting and recreational trips to Marin and Sonoma Counties.

The high capital investment in station locations also makes the subsurface routes less flexible to meet future changes in employment locations.

4. Existing Urban Environment

a. Lombard Segment

The western boundary of this segment is surrounded by military and institutional land uses including Letterman Hospital which is a major regional attraction. The busway would be located in a subsurface configuration beneath Richardson and Lombard Streets which are characterized as mixed residential and commercial land uses. Lombard Street is basically an auto-related retail strip.

The Lombard segment is surrounded by two census tracts having a total population of 9,341 persons. The area has a higher median family income ($14,053) than the city average ($10,503). Fewer than 6% of the families have incomes below the poverty level, compared to the city average of about 10%.

There is a lower percentage of owner-occupied dwellings (21.6%) than the city average (31%). Also, a lower percentage of families has lived in the same residence for five years.

Over half the acreage of the two census tracts is residential and about 8% is commercial. The remainder is distributed among other uses. Population and employment forecasts for 1990 indicate very little change.

b. Russian and Telegraph Hill Segments

The route would pass beneath Telegraph and/or Russian Hills in a deep bedrock bored tunnel. Russian Hill is predominantly a residential neighborhood. On either side of this route segment are four census tracts with a population of almost 15,000. Median family income of $13,023 is $2,520 higher than the city average. A lower percentage of families (5.4%) is below the poverty level than for the city. Home-ownership as most residents in this area are apartment dwellers, is below the city average. The area is similiar to the city average in terms of the percentage of persons living in the same residence for five years or more.

About half the net acreage of the four census tracts is residential; less than 10% is commercial. As in the Lombard segment, population and employment forecasts for 1990 indicate very little additional growth.

c. Financial District Segment - Kearny Route

This route segment passes under the North Beach residential area and Financial District regional employment center. North Beach broadly encompasses portions of Telegraph Hill, Russian Hill, and Chinatown residential neighborhoods. Columbus Avenue is a major commercial street generally located on the edge of the residential neighborhoods within North Beach. The route generally follows the most westerly edge of the Financial District adjacent to the retail district.

There are ten census tracts which surround the route with a population of 40,641 persons. The highest density of population is in Chinatown. Median family income of $8,288 is $2,215 below the city average. Compared to the city average, a slightly higher percentage of families have incomes below the poverty level. The percentage of owner-occupied units (7.1%) is lower in these tracts than the city average of 31%. A lower percentage of persons (38%) have resided at the same address for five years or more than for the city as a whole (48%).

The land uses in these census tracts are quite diverse, reflecting the wide range of activities taking place in this portion of the city. Almost 30% of the net acreage is commercial; 16.5% is residential; 9.7% is parking garages or lots; and the remainder is divided among industrial, institutional and public uses.

Very little population and employment growth is expected for the area surrounding the entire Kearny route north of Washington Street.

By 1990, employment in the area surrounding the route alternative south of Washington Street within the Financial District is expected to grow by 50,000 new jobs or over 21%. Some population growth is expected; however, it is not substantial.

d. Financial District Segment - Battery Route

The Battery subsurface route would vary from the Kearny subsurface route east of Columbus Avenue. The Battery route would continue under Telegraph Hill as opposed to the turning south on Columbus. From Lombard Street the route would turn south at Battery and would continue to First Street enroute to the Transbay Terminal. This final segment, designated the Battery Segment, would pass through the Northern Waterfront, Jackson Square, and Financial District.

The route would encompass six census tracts which have a combined population of 16,790. Median family income of $9,491 is about $1,000 lower than the city average. About 14% of the families have incomes below the poverty level.

Almost all the residents of this area rent rather than own their units; only 1.1% of the units are owner-occupied. Turnover in the area is higher than the city average. Only 20% of the people in the area have lived at their current address five years or more, compared to a city average of 48%.

Reflecting the downtown location of these tracts, about a third of the net acreage is commercial, 14% is parking-related, and only 2.6% is residential.

Forecasts for the area surrounding the route indicate that for the period between 1970 and 1990 employment will grow by over 50,000 jobs or 21% and population will increase by over 6,000 persons or 22%.

5. Construction Disruption

There would be major disruptions to traffic and neighborhoods in the implementation of the two subsurface route alternatives. However, these routes have been designed to utilize the maximum amount of tunneling construction techniques as opposed to cut-and-cover where economically feasible in order to minimize disruption to the physical and social environment in terms of duration, degree, and nature of disruption.

a. Noise

Noise levels of construction operations shall be required to conform to the acceptable levels for various zoning classifications and times of day as defined in the San Francisco Noise Ordinance (see Environmental Criteria, Appendix V).

The noise from construction operations depends on the combination of the equipment used which varies with the type and phase of construction. Construction noise of tunneling operations at the tunnel portal would consist mainly of large trucks hauling away spoils. Noise from the construction of the vent structures would come from the operation of a crane combined with other general construction noise. The initial phase of station construction and the cut-and-cover portions of the underground alignment will create the most noise. The construction equipment pieces required for the various construction phases is presented in the following table.

EQUIPMENT REQUIREMENTS AND DURATION OF USE

Construction Type	Equipment Requirements	Duration
Tunneling Operations	Two large trucks	18 - 36 months
Vent Construction	Compressor, crane, excavator	24 months
Cut-and-Cover		
Phase I-Street Excavation	Jack hammer (1), compressor (1), transit mix truck (1), trucks (2), excavator (1)	2 months
Phase II-Subsurface Construction (street covered)	Transit mix truck (1), trucks (2), compressor (1)	13 mo. (Busway) 36 mo. (Station)
Phase III-Street restoration	Trucks (2), grader (1), paver (1)	1 month

Noise estimates of construction equipment operations presented below are determined by using an evaluation process presented in Dagobert Marggrat's "Noise from Construction Machinery," an article in the October 1974 issue of World Construction.

Noise emission is defined as the radiation of sound to the environment and noise immision is defined as the effect of the sound on the environment.

Each type of equipment has a broad range of noise emission potential. The higher noise levels are associated with large unmuffled machinery and the lower levels with smaller machinery equipped with sound absorbing components and materials. The following table presents these ranges in terms of the noise emission level realized at 7 meters from the noise source. Also shown is the noise level expected of the equipment to be selected for the construction of this project.

NOISE CHARACTERISTICS OF CONSTRUCTION EQUIPMENT

Equipment	Loudest Operating Mode	Noise Emissions dBA at 7 meters Range	Expected
Mobile compressor	empty, running	67-90	75
Crane	work cycle	67-89	70
Wheel loader	stationary	76-92.5	80
Transit mix truck	loaded	70-76	73
Jack hammer	work cycle	77	77
Excavator	work cycle	77	77
10-ton truck	loaded	70-76	73

Noise level decreases with increasing distance. The magnitude of this attenuation effect depends on the nature of the area surrounding the noise source. A strongly reflective noise field such as the highly built-up downtown streets provides for less sound reduction than the less disturbed noise fields such as the moderately built-up areas north of Central Business District.

The table below defines the amount of decibel reduction experienced in a free field and the type of noise fields in the study area. These values are subject to change due to the atmospheric conditions including wind, temperature, and humidity.

Distance From Source	Free Field	Substantially Reflective Field	Strongly Reflective Field
7m	0	0	0
14m	6	4	3
28m	12	8	6
56m	18	12	9
112m	24	16	12
224m	30	20	15
448m	36	24	18
896m	40	28	21

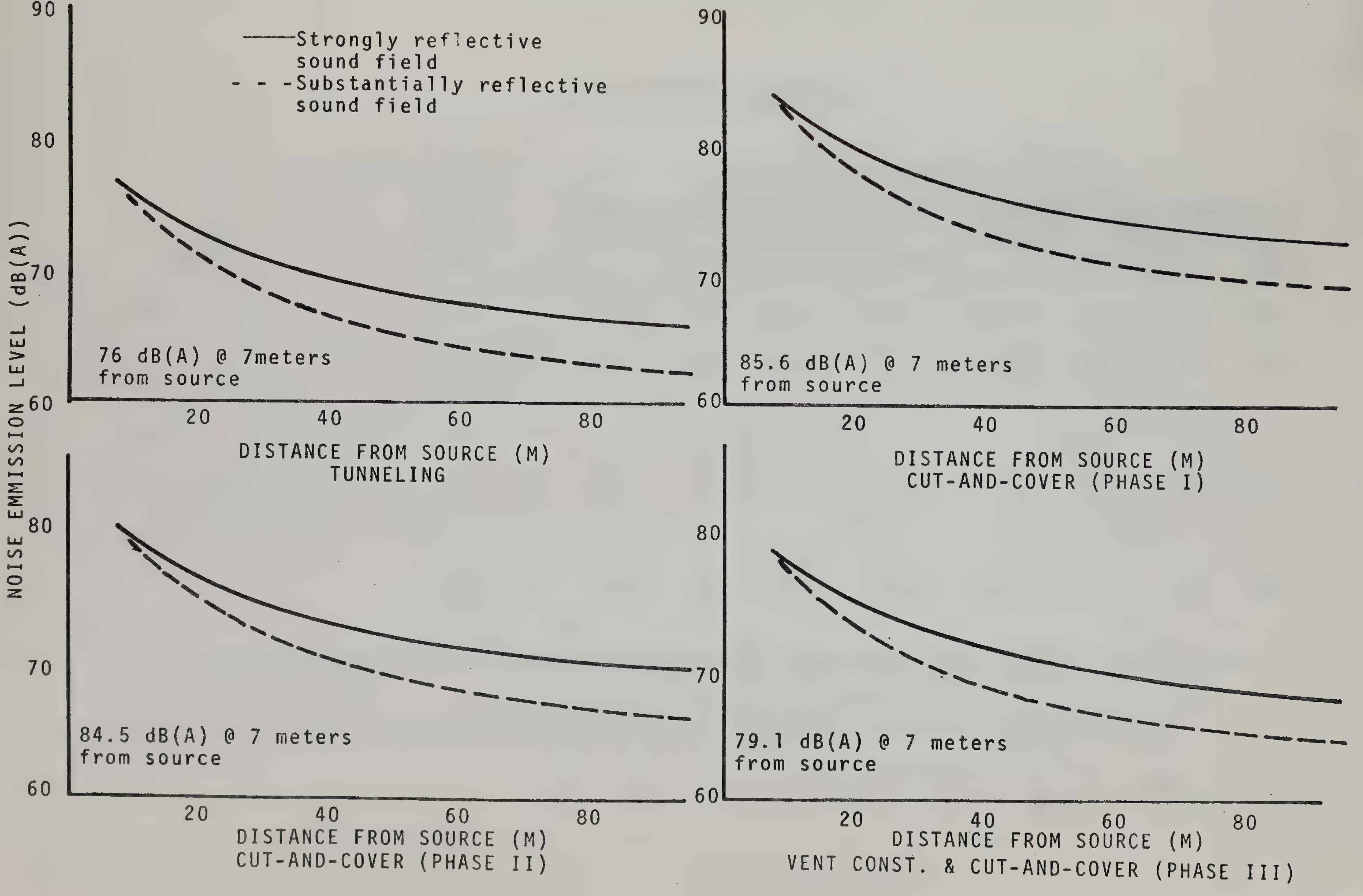
Once the noise emissions from individual machines at a given distance are known, the collective emission level including the ambient noise level can be determined.

The expected noise levels from the various types and phases of the construction is shown on the graphs on the following page. The ambient noise level was assumed to be 70 dBA in all cases. The noise level of vent construction is approximately equivalent to that of the street restoration phase of the cut-and-cover operations. The following table defines the extent of areas by land use subject to noise impacts during the construction phase greater than the desired ambient noise limits established by the San Francisco Noise Ordinance. Values shown in this table assume that all construction will take place during the daytime only. Strongly reflective noise fields apply to extensively built-up urban areas containing a large proportion of high rise buildings. For the most part, these values are only true for those areas which have unobstructed exposure to the noise source. There are also many areas within the adversely affected zone experiencing ambient noise conditions greater than those realized from the construction operation. Noise impacts for truck traffic for tunneling operations were not considered since it is assumed that the ambient noise level of the traffic flow of the haul routes will be greater than 76 dBA.

Employment of baffles either in the form of mounds of earth or construction materials can reduce immission levels 10 to 15 dBA. For many areas, this practice would adequately mitigate adverse noise impacts. However, in some residential areas, cut-and-cover operations would impose noise levels which could not be adequately screened. Such areas are shown in Figure V-42. Other possible mitigation practices include:

- Utilization of muffled machines
- Use of machines with lower power output
- Alteration of scheduled use of a single machine to maximize use over shorter periods
- Employment of construction techniques which require less noisy equipment
- Negotiations with affected businesses and residences to work out most reasonable schedule

NOISE EMMISSION CURVES FOR VARIOUS CONSTRUCTION ACTIVITIES



NOISE IMPACT EXTENT

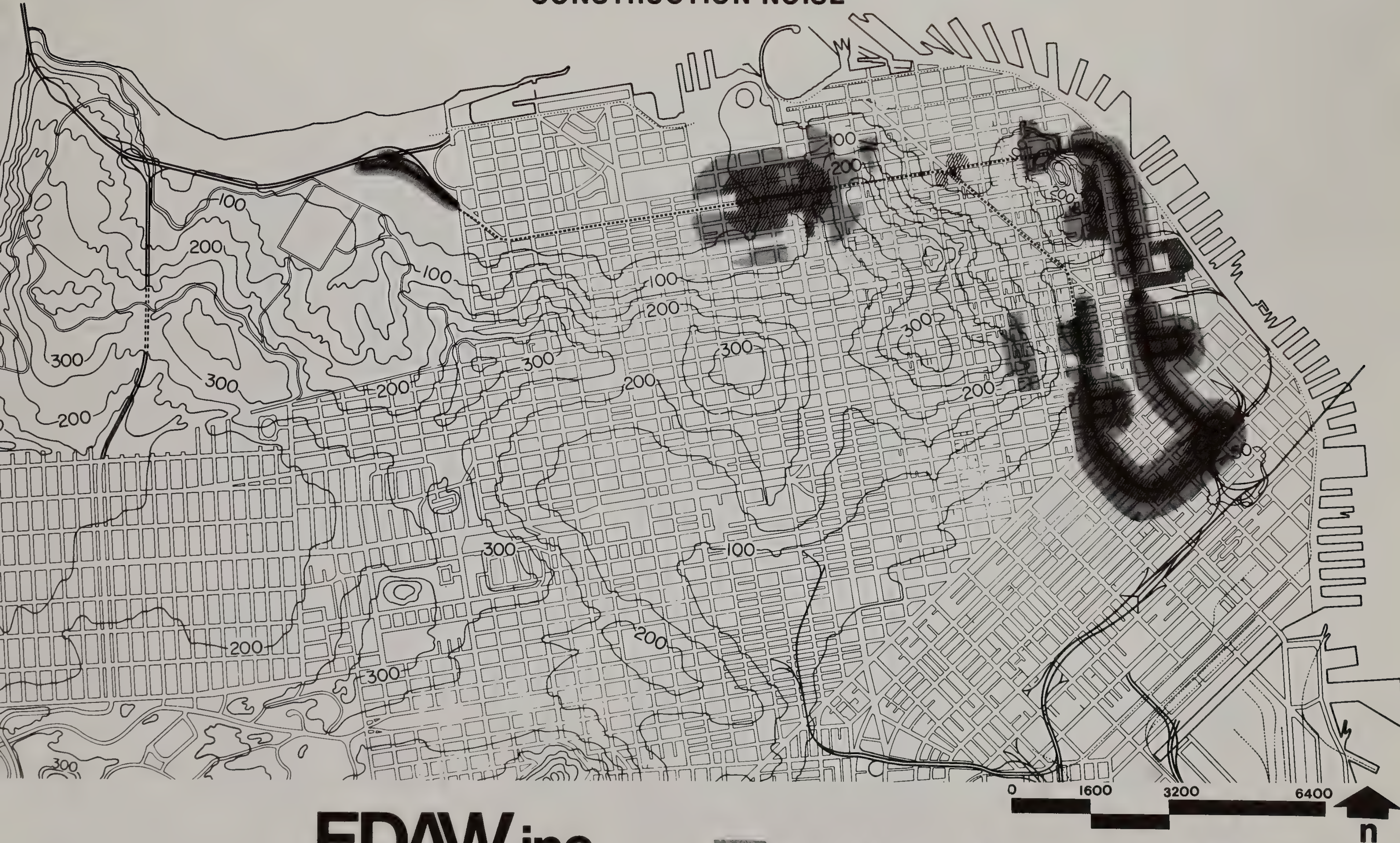
Zoning District	Desirable Ambient Sound Level dBA	Distance from Sound Source Subject to Increase Imission Effects (Meters)							
		Substantially Reflective Field				Strongly Reflective Field			
		Tunneling	Cut-and-Cover			Tunneling	Cut-and-Cover		
			Ph. I	Ph. II	Ph. III**		Ph. I	Ph. II	Ph. III
R-2	55	275	910	520	225	N/A*	N/A	N/A	N/A
R-3, R-3.5 R-4, R-5, R-3-C, R-3.5-C, R-4-C, R-5-C	60	120	420	230	120	310	780	570	510
C-1, C-2, C-3-0, C-3-R, C-3-G, C-3-S, C-M, M-1	70	21	60	40	30	31	130	72	57
P	80	OK	11	8	OK	OK	8	8	OK

* N/A no zoning districts of these classifications could be considered strongly reflective (one and two story buildings only).

** Vent construction noise approximately equivalent to Phase III cut-and-cover noise level.

FIGURE V-42

CONSTRUCTION NOISE



Phase I Cut & Cover : 2 months

Phase II and III Cut & Cover and Vent Construction : 18 - 36 months

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The following table compares the extent of the areas affected by the construction noise for the two alternative subsurface routes.

	Kearny Street Alignment	Battery Street Alignment
Number of workers	69,000	74,500
Number of residences	6,300	7,900

b. Dust and Air Pollution

All areas adjacent to cut-and-cover and vent construction operation are subject to air quality inputs during the construction phase. Also, the trucks hauling spoils from the tunnel boring operations create dust and air pollution on whatever streets they travel on. In regard to vehicle operation-related air pollution, the construction equipment would impose pollutants no different than the car, bus, and truck emissions of a conventional traffic flow. Streets where all major construction activity is to occur presently carry heavy traffic loads. Assuming that they will be high volume corridors in 1990, the increase in air pollution due to the operation of a few units of construction equipment will be insignificant in comparison to the tens of thousands of vehicle trips passing through the construction site.

Street excavation and street restoration operations, as well as all earth hauling activities, could subject adjacent areas to increased dust levels. These adverse effects can be controlled by strict enforcement of extensive dust abatement requirements which will be made a part of all construction contracts. These measures will include load limits on dump trucks, sprinkling requirements, and loading operations. However, project construction does pose possible increases in dust impacts to adjacent areas proportionate to the extent and duration of surface operations.

Haul routes should be restricted to those streets which carry the greatest proportion of heavy truck traffic. Selection of spoil sites should take this problem of egress into account.

c. Traffic

The streets above cut-and-cover construction will have major traffic disruption during construction. This disruption will be most severe during the early months of construction before the temporary decking is in place. However, even with the decking, traffic speeds and streets capacity will be greatly reduced for periods up to 3 years.

A serious disruption will occur at the intersection of Lombard Street and Van Ness Avenue due to station construction and the tunnel construction under Russian Hill.

Cut-and-cover construction will disrupt traffic along Kearny Street from Sacramento Street to Market Street, and on Third Street to Howard Street. Disruption will also occur on the cross streets including Clay, Commercial, Sacramento, California, Geary, Market, Stevenson, Mission, and Howard Streets.

The Battery alignment will have similar disruptions along Battery Street from Lombard Street to Market Street and on First Street to Howard Street.

Minor disruptions will also occur to the cross streets at Union, Green, Vallejo, Sacramento, Market, Mission, and Howard Streets as well as the intersection of Sansome and Lombard Streets.

The Financial District station with both alternatives will have a lengthy disruption for the blocks involved. The Battery alignment also will disrupt the California Street cable car line between Battery and Davis Streets.

Appendix VIII, Economics, contains a cost analysis of the construction impact on traffic.

d. Disposal of Excavation Material

Both of the subsurface alternatives would have approximately the same amount of excavated material (estimated at 1,300,000 cu yd). Possible disposal sites for this material are yet to be determined. The construction cost estimates assume disposal to be to the south either between India Basin and Island Creek or between Hunters Point Naval Shipyard and Candlestick Park.

e. Miscellaneous Street and Utility Work

In addition to the utility relocation in cut-and-cover construction areas, there may be utility repairs and replacements required in the tunnel construction sections due to subsidence during tunneling. Subsidence is most likely to occur in the Bay fill area along the Battery Street alignment. The subsidence problem is discussed in more detail in Section V.7h of this report. Thus, there may be more street construction and its associated noise and disruption to street traffic along Battery Street, than is indicated in the above discussion.

6. Urban Impacts

The urban impacts described below are shown in Figures V-43 - V-45B.

a. Displacement

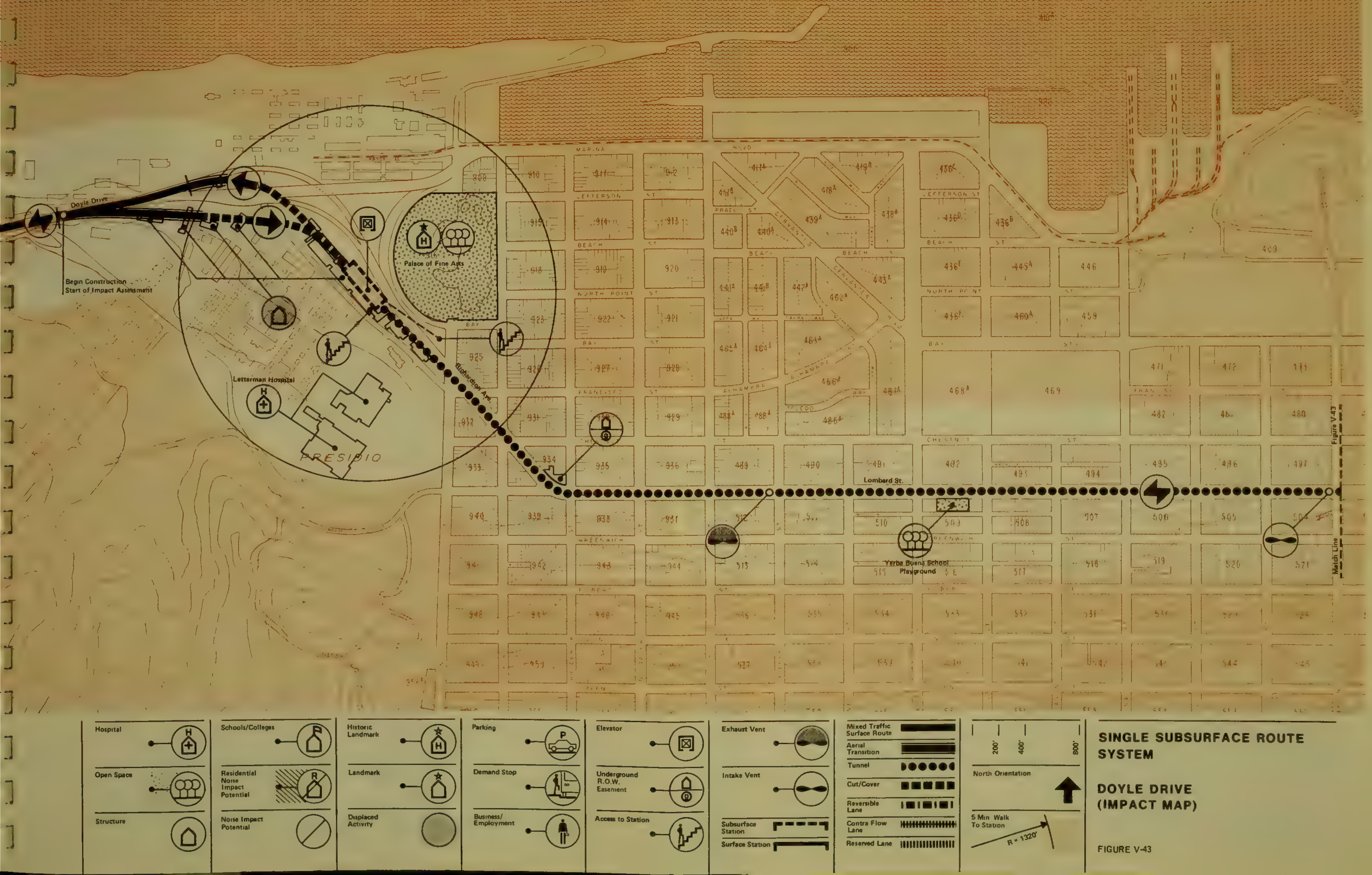
A few parking spaces are displaced where sidewalks are widened to allow for station entrances. Approximately 64 square feet of private property is required for an intake ventilation structure for each station. The final site for these intakes may result in partial displacement of some activity.

Major areas of displacement occur where the route is in transition between aerial and subsurface alignment. The Doyle Drive transitional alignment displaces ten military warehouse buildings. However, these buildings are scheduled to be abandoned in the next few years because of their functional obsolescence. Displacement also occurs for both route alignments in the vicinity of the Transbay Terminal. For the Kearny alignment the displacement includes mainly brick commercial buildings up to three stories and parking spaces. The Battery Street alignment also displaces commercial buildings and parking spaces in the vicinity of the Transbay Terminal where a transitional spiral structure rises from the subsurface alignment to the elevated busway at the Transbay Terminal. However, the Transbay Terminal Authority is considering redeveloping the Terminal. If the redevelopment plans provide for a subsurface busway the transition structure and associated displacement would not occur.

b. Visual and Physical Impacts

Since the route is subsurface, no physical impacts occur. For this subsurface route, visual elements include the vent structures, station entrances, and aerial or at-grade transitional route alignments.

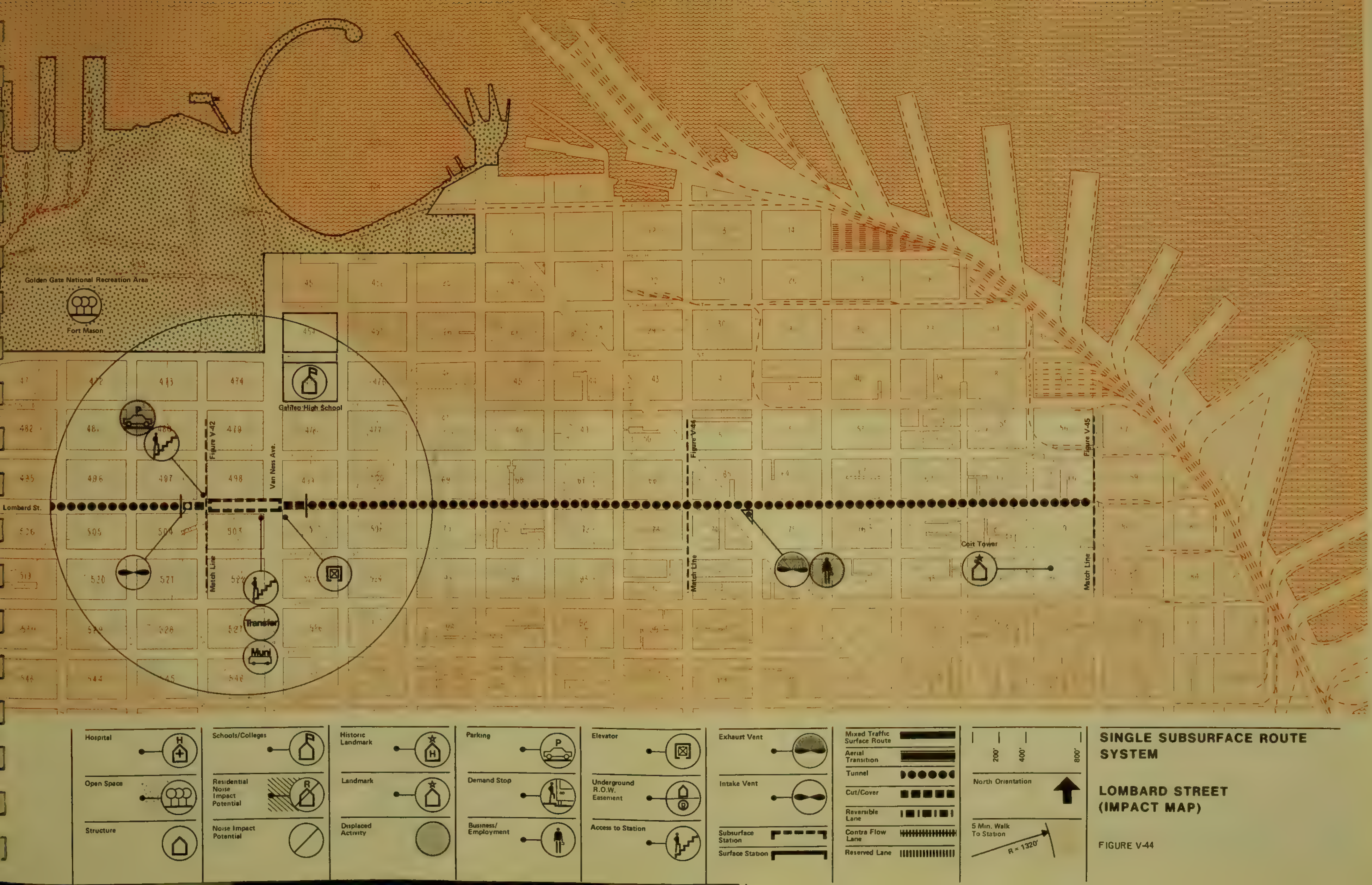
The exhaust ventilation structure discussed under the single-lane tunnel will be required for the subsurface routes and is illustrated in Figure V-18A. The transition structure connecting to the existing Transbay Terminal would present little visual impact since it is located next to existing freeway or busway aerial structures.



SINGLE SUBSURFACE ROUTE SYSTEM

DOYLE DRIVE (IMPACT MAP)

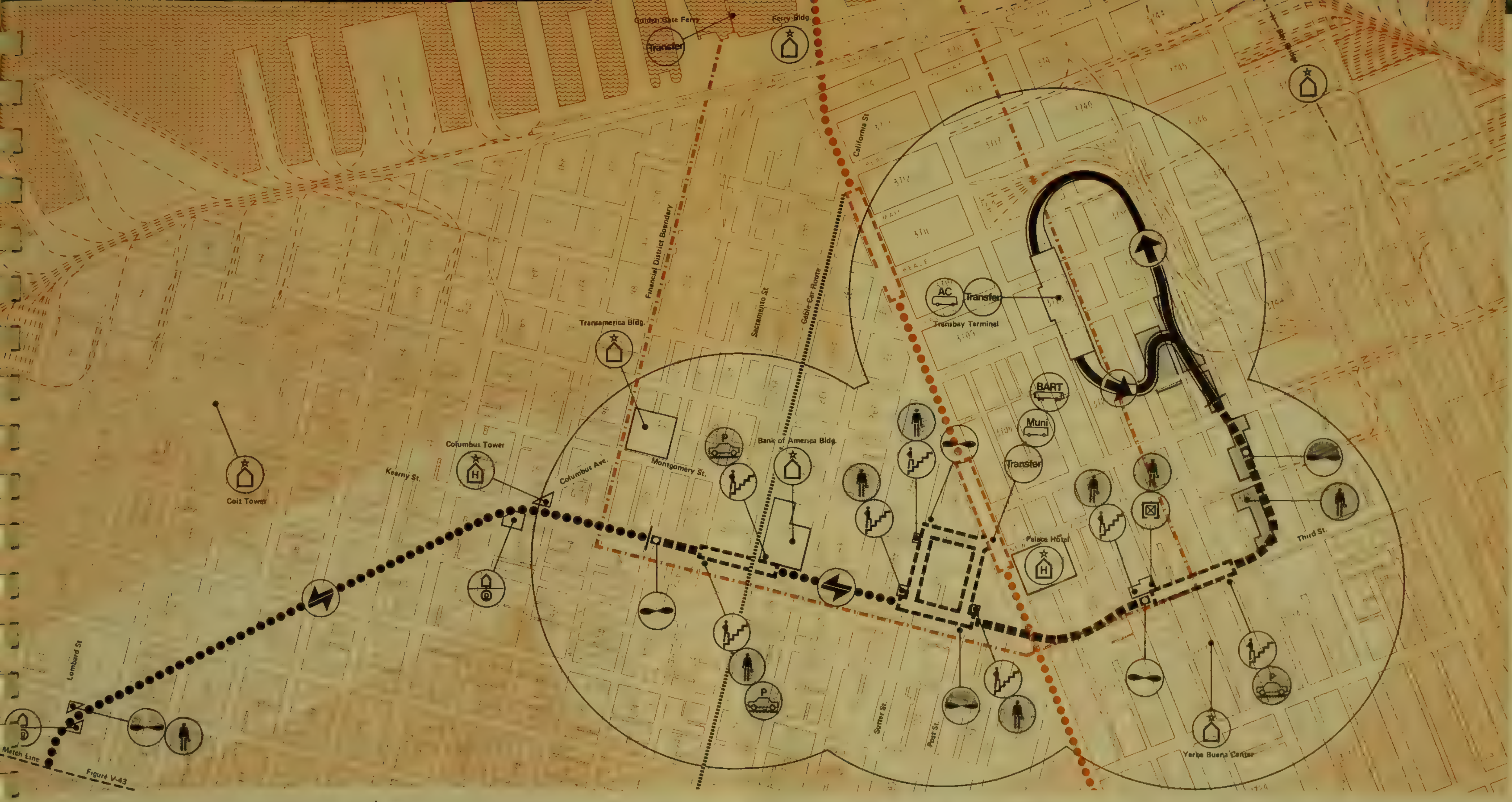
FIGURE V-43



SINGLE SUBSURFACE ROUTE SYSTEM

LOMBARD STREET (IMPACT MAP)

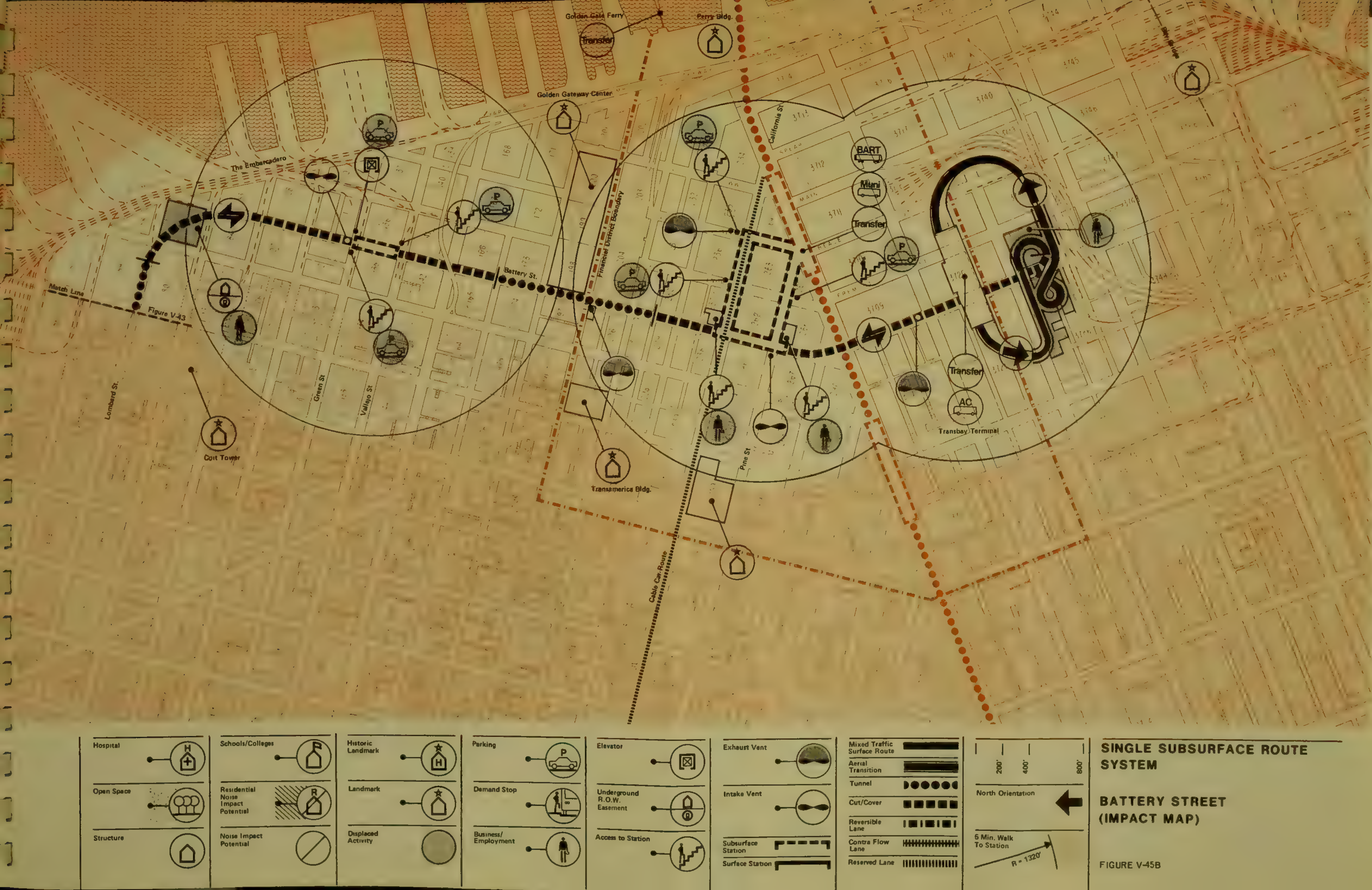
FIGURE V-44



SINGLE SUBSURFACE ROUTE SYSTEM

COLUMBUS-KEARNY
(IMPACT MAP)

FIGURE V-45A



SINGLE SUBSURFACE ROUTE SYSTEM

BATTERY STREET (IMPACT MAP)

FIGURE V-45B

c. Land Use

The major quantifiable land use impact would be the reduction of parking land area required. Patronage figures for the subsurface routes indicate that a significant number of persons driving to and parking in the Financial District will be diverted to transit because of improved service. The net result for the Kearny alignment is that the land requirement for approximately 2,300 parking spaces or 16 acres of land could be converted to more productive uses. The Battery Street route results in approximately 2,500 fewer parking spaces or 17 acres less devoted to parking in the Financial District.

Other land use changes which are less quantifiable are the amount of clustering of commercial office space around the subsurface stations. The Financial District is far more likely to experience the intensification of commercial land use around stations than the outlying neighborhoods due primarily to zoning regulations and city policy which prohibit intensive development in the city's residential neighborhoods. Employment forecasts for the area around the Kearny and Battery Streets Financial District stations indicate growth of approximately 50,000 jobs by 1990 requiring about 10 million square feet of new commercial office space. Data interpreted from the Zoning Map, Figure III-9A and the Development Potential Map, Figure III-10 indicate that within a 5-minute walk of the stations in the Financial District, there exists 45 and 35 million square feet of developable floor area on underutilized parcels for the Kearny and Battery routes respectively. This is considerably more than the 20-year projection demand. For the Kearny route much of this vacant development prone land is located within the Yerba Buena Redevelopment Area which is served directly by a station at Third and Howard Streets. For the Battery route most of the vacant developable land is located within the Golden Gateway Redevelopment Area within a short walk of the Financial District Station.

d. Joint Development

In the discussion of the architectural and urban design treatment of subsurface stations, reference was made to joint development opportunities that the station design affords. The City of San Francisco encourages development of new

buildings within the vicinity or connected to regional rapid transit facilities in the Financial District. The development bonus increases the permitted building area by up to 20% of the allowable base floor area. While it is not anticipated that the subsurface route will increase employment beyond that forecasted for 1990, it is likely that projected employment and consequent space demand will concentrate around stations to take advantage of the development bonus and the added amenity of convenient transit access.

e. Public Policy Implications

The subsurface route alignments offer a potential conflict with the Transportation Element of the San Francisco Comprehensive Plan. The Plan calls for only one subsurface route in Northwest San Francisco for both MUNI and Golden Gate and the recommended alignment indicated in the Plan calls for it to be located below Geary Blvd. The Geary Blvd. route was studied in conjunction with the Northwest Rapid Transit Extension Project and subsequently dropped by Golden Gate Board of Control's action. Nonetheless, the policy conflict with San Francisco's Plan has not been resolved.

7. Environmental Impact

a. Air Quality

The ventilation system will be designed to meet the prescribed Federal Occupational Safety and Health Administration (OSHA) limits for pollutants associated with the operation of the bus tunnel system. The controlling pollutant is the nitrogen oxide (NO_x). Fans are designed to provide 20 changes per hour during peak traffic to maintain the NO_x concentration at a safety level of 2.0. The ventilation rate of each section of the system will be carefully established to assure that this standard is met.

The following table shows the expected concentrations in the tunnel air during peak operating conditions and emergency conditions (assuming 20 changes per hour).

	O.S.H.A. MAX. LIMIT mg/cu meter	PEAK CONDITIONS mg/cu meter
Carbon Monoxide (CO)	55	4.1
Nitrogen Dioxide (NO_x)	9	9.0
HydroCarbons (HC)	-	0.8

These concentrations will occur only within the tunnel and in close proximity to the vents. However, once it dissipates, the impact on air quality is the same as it would be if the buses were operating on the surface. The dissipation rate would be subject to weather conditions including wind, barometric pressure, temperature, and humidity.

The attraction of additional bus patronage from the auto over the existing bus operations in mixed traffic will result in the following reduced pollutants per day: 1.25 tons of CO, .038 tons of HC, and .049 tons of NO_x.

The most practical means for reducing the amount of pollutants emitted from the subway vents is to reduce the pollutants emitted at the bus source.

b. Noise

The subsurface alternatives have the beneficial impact of eliminating all noise associated with the Financial District buses operating on surface streets. The only noise from the bus vehicles will be at the portals. The noise at The Presidio portal will be masked by the noise of the adjacent heavy traffic flow on Doyle Drive.

The ventilation equipment can be designed and operated in a manner that will not exceed the noise limits prescribed in the San Francisco Noise Ordinance.

c. Land Forms and Vegetation

The location of the proposed improvements is a highly urban area characterized by expanses of paved streets, tall and moderately tall high density buildings, and minimal landscaping. No natural elements will be affected. Trees in the Financial District area where cut-and-cover construction is required will be replaced following construction.

d. Micro Climate

The physical presence of the system will not cause any variations in existing wind patterns. Any difference in temperature between the exhaust air and ambient air at the vent opening will not be measurable at a distance of 6 to 7 feet from the vents.

The operation of the ventilation facilities will affect air movement in the immediate vicinity of their openings. These vents will be in the form of street grates (not less than 400 square feet in area) which will direct the air vertically at a velocity not to exceed 7 feet per second (less than 5 miles per hour) at the peak exhaust rate. Except for these minor changes at the exhaust vents the proposed subsurface routes do not present any significant impact to micro climate quality.

e. Energy Resources

An estimated 6,000 to 7,000 gallons of fuel would be saved per day in 1990 by the bus patrons attracted from the auto due to the subsurface route improvements.

f. Hydrology

In regard to long-term impacts, the project crosses no natural surface drainage courses. Assuming that provisions are included in the final design for restoration or relocation of the city's storm drainage system which are affected by the project, no long-term impacts to surface hydrology are foreseen.

Ground water will be affected by dewatering during construction operations; however, after the project is completed, the ground water will return to its normal level. The limited amount of ground water which occurs in the city is not a major resource. There are no possible impacts on flood plains to consider.

Short-term hydrological impacts include the possibility of the disposal of ground water pumped from excavations being the source of pollution if not properly controlled. Water pumped from dewatering wells should be free of silt or sand to prevent both excessive ground settlement and clogging of storm drains.

Proper design and installation of dewatering systems and controls of disposal areas can eliminate adverse impacts. Water from dewatering operations will most likely be disposed into storm drains and carried to the Bay. If this water is kept free of silt, clay, and other debris, no significant pollution problems are anticipated.

g. Geology

The project will encounter a variety of rock and soil conditions ranging from hard bedrock to soft Bay mud as shown on the plan and profile sheets. Bedrock consists of rocks of the Franciscan group and includes sandstone, shale, greenstone, and sheared rocks. These rocks range from deeply weathered "rotten rock" to relatively fresh, hard rocks. The Franciscan rocks have been complexly folded and faulted and contain numerous shear zones. Along most of

the project route, the bedrock is overlain by unconsolidated sediments of the Colma Formation, slope debris, dune sand, and artificial fill. The Battery Street alternate crosses a filled portion of the Bay between Broadway and Mission Streets (Stations 260+00 and 290+00). This section is underlain by thick soft Bay mud deposits and artificial fill.

If the project is carefully engineered and constructed to fit local ground conditions, no long-term impacts to the geologic environment are envisioned. The project will be, for the most part, buried beneath paved city streets and will have no effect on surface geologic features. Portals and above-ground structures are located in areas of flat or gently sloping terrain so that landsliding or other slope-related geologic hazards will not result from implementation of the project.

Excavation for the project will encounter a wide variety of rock and soil materials including deeply weathered, sheared rock, loose saturated sands, and, on the Battery Street Alignment, soft Bay mud. Caving or running ground in excavations can lead to ground settlements on adjacent properties. Construction dewatering of saturated soft sediments can also lead to ground settlement. Ordinarily, adjacent buildings which are founded on piles are not affected by these settlements, but there is some probability for streets, sidewalks, and utilities adjacent to cut-and-cover or soft ground tunnel construction operations to suffer some damage from ground settlements. Excavation of these tunnels and open cut structures are subject to these ground stability problems, if not properly designed and carefully constructed.

With modern construction practices, damages to adjacent property or structures resulting from vibrations associated with underground blasting are very rare. Preconstruction surveys, mili-second delayed blasting sequences, and instrumentation of vibrations have generally alleviated the problem of vibration-caused damages. Where tunneling machines are used in lieu of conventional blasting methods, vibrations are reduced to still lower levels.

The project will be constructed in a highly seismic area. Although no major faults are crossed, the project area will be subjected to moderate to severe seismic shaking within the economic life of the project. Underground structures are generally less affected by seismic shaking than above-ground structures. However, where local ground conditions are subject to seismically induced ground failures, such as liquefaction, severe enough to cause major damage to above-ground structure, underground structures may be severely damaged as well.

Detailed investigations along the selected project route should be conducted prior to construction to determine local ground conditions and potential ground instability problems. The project should be designed to fit local conditions, specifications carefully written, and construction carefully controlled to prevent adverse settlement adjacent to excavations. If it is determined during the design of the project that construction dewatering will cause unacceptable ground settlement, alternative ground water control methods, such as slurry walls, should be considered. With proper design and construction, impacts from ground stability problems can be eliminated. Especially critical is the section of the Battery Alignment on Battery Street that is in the Bay mud. Analyses of expected ground accelerations along the alignment should be made and both underground and surface structures should be designed to withstand seismic forces. The potential for liquefaction or other seismically induced ground failures in Bay mud and saturated dune sand should be fully assessed and taken into account in the design of the structures involved.

8. Fact Sheet

A summary table, comparing the subsurface routes with the existing system, is on the next page. The data on this table is based on the assumptions and factors described in Section V4, and the description and analysis presented in Section VC.

SUBSURFACE ROUTES FACT SHEET
(1990 Conditions)

Item	EXISTING SYSTEM	SUBSURFACE ROUTES	
		Kearny Route	Battery Route
Travel Time. From Toll Plaza to Financial District Station in minutes.	28.6	9.4	9.6
Patronage. 1990 one-way, peak period			
-Bus riders	11,700	14,700	15,000
-Number of buses to financial district	97	144	148
-Total number of buses	147	184	188
-Auto reduction	0	2,300	2,540
Accessibility. Number of people within 5 minute walk of service in San Francisco			
-Employees	282,000	237,000	249,000
-Residents	75,000	65,000	59,000
-Transit dependents	31,000	28,000	24,000
Short-Term Impacts.			
-Construction disruption		Severe	Severe
-Construction employment in person-years		Over 4,000	Over 4,000
Long-Term Impacts.			
-Number of dwelling units along route	4,849	None	None
-Air pollutants (percent reduction)		4.3	4.8
-Fuel consumed(1)	142,500	6,300 Less	7,000 Less
-Traffic conflicts	Severe	None	None
Displacement.			
-Number of employees		859	567
-Number of businesses		42	26
-Number of parking spaces		115	105
Service Life. Approximate year congestion will degrade service below current level	1975	N.A.	N.A.
Cost Data. (1975 dollars)			
-Capital cost		273,000,000	284,000,000
-Operating cost	3,700,000	3,900,000	3,800,000
-Annual $ benefits derived d		3,790,000	3,920,000
-Incremental benefit/cost ratio		.33	.33

(1)Gallons of fuel used per day by buses and autos.

D. DISPERSED SURFACE ROUTES

The goal of the dispersed route concept, shown in Figure V-46, is to spread the bus load to many streets and thereby enable the buses to continue to operate in mixed traffic without preferential treatment.

1. Description of Routes

The concept uses the existing bus route system as a starting point, including the direct service to the Transbay Terminal via The Embarcadero. When a section of the route becomes congested, a new parallel route would be added.

The most likely section to reach the congestion stage first is Lombard Street. When this occurs, the current Civic Center service would be rerouted via Park Presidio Avenue and Geary Blvd. to Van Ness Avenue where it will continue on the present route alignment. This change could reduce the bus load on Lombard Street up to 40%, assuming that patrons destined for south of Market Street and Third Street would use the Civic Center rather than the Financial District service. The travel time to the Civic Center by the Park Presidio route is 22 minutes which is the same as the current route. The bus passengers to western San Francisco would have more direct and quicker service to their destination with the Park Presidio route while the passengers destined for Van Ness Avenue between Lombard Street and Geary Blvd. would have a transfer or longer walk.

The biggest congestion point on the Park Presidio route is in the morning peak at the intersection of Park Presidio Avenue and Geary Blvd. Left-hand turns are prohibited so the buses must take a right at Clement Street, left onto Fifteenth Avenue, and left onto Geary to cross Park Presidio Avenue.

When this intersection and Geary Blvd. become congested, a new parallel route via California Street, Pine and Bush Streets, Laguna Street, McAllister and Grove Streets, Seventh and Eighth Streets, and Howard and Folsom Streets would be started. The California Street route would take only 0.3 minutes longer to the Civic Center than the Geary Street route. There are some serious bus operating problems on portions of this route, especially on Laguna Street, due to

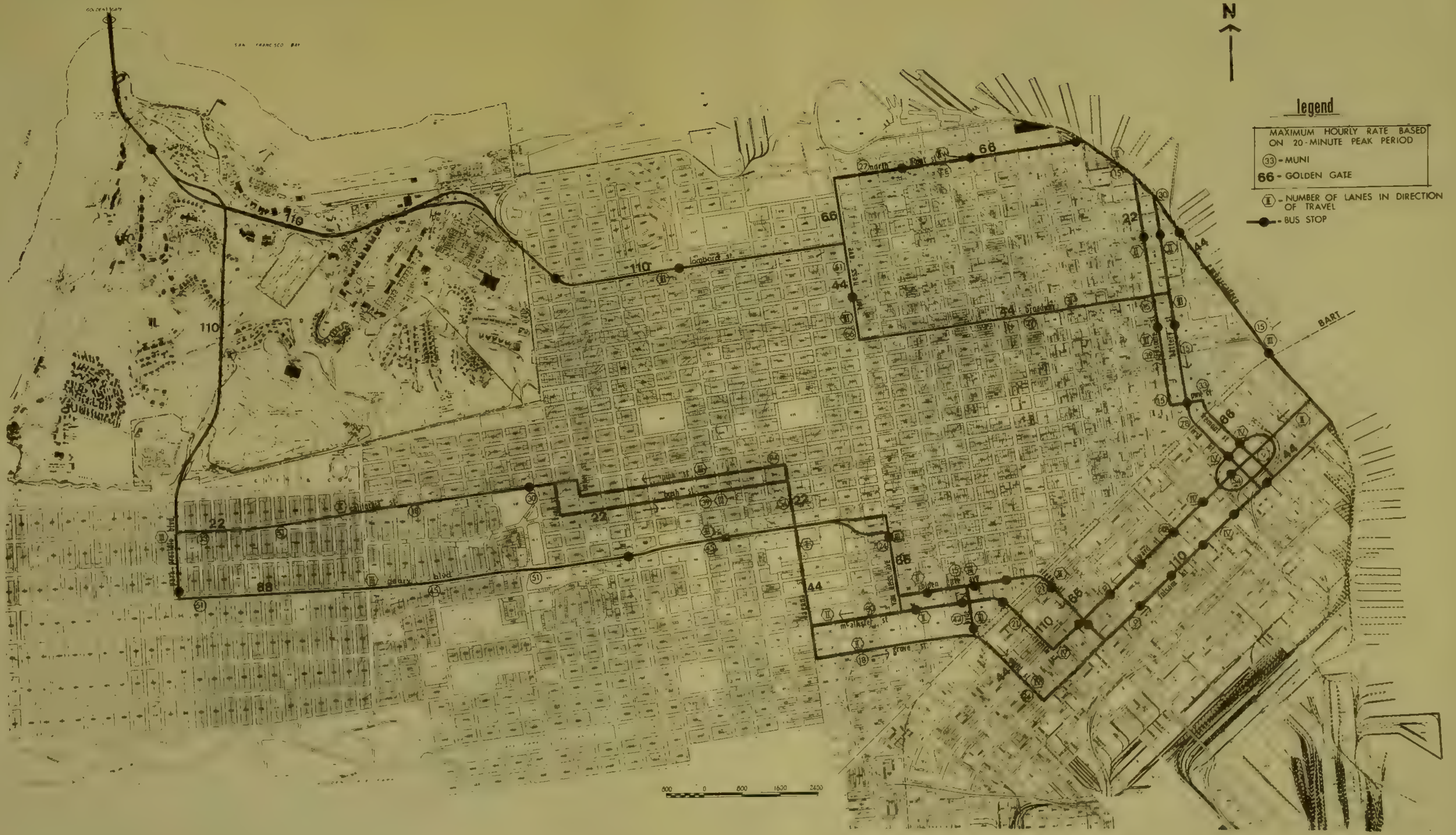


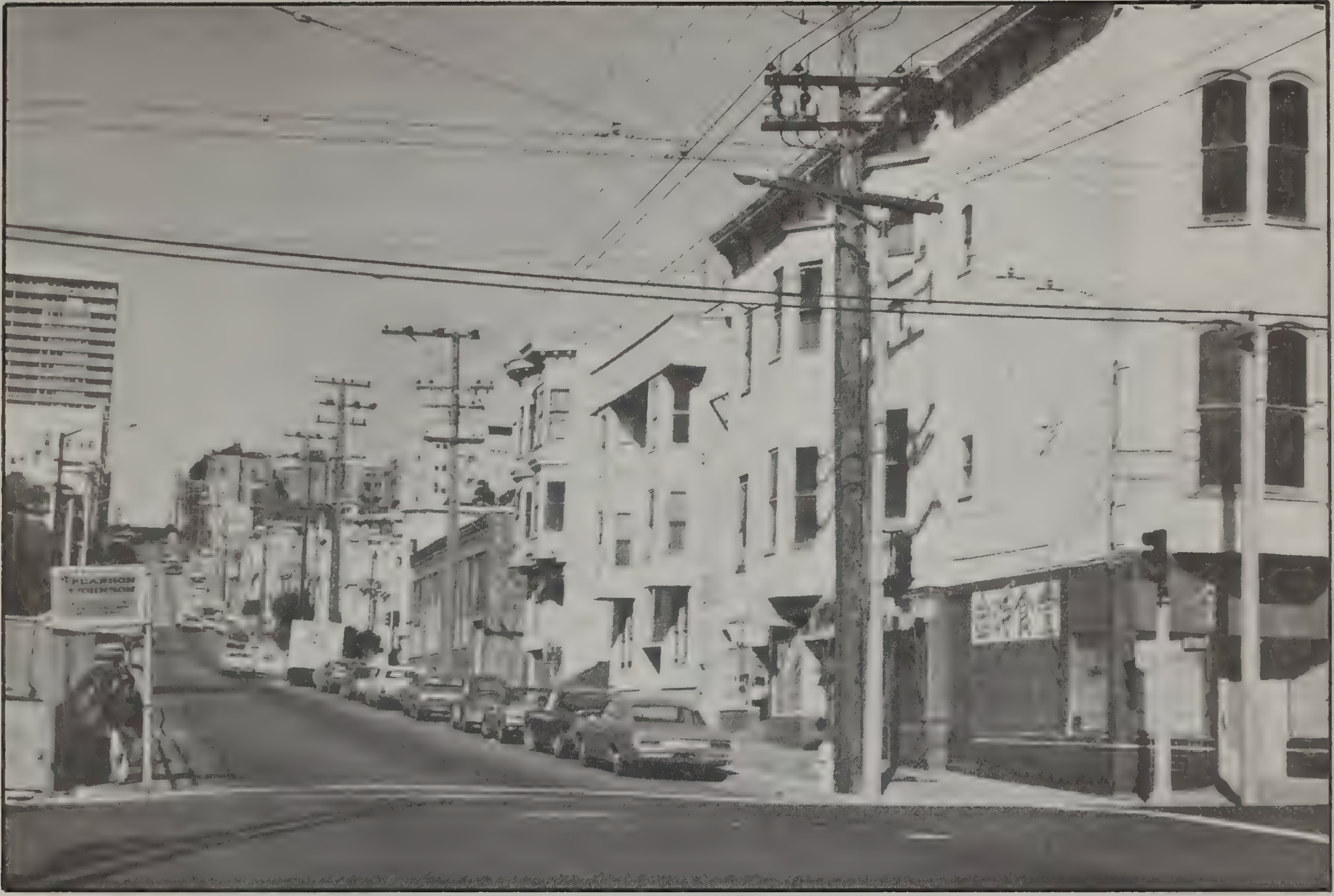
FIGURE V 46

DISPERSED SURFACE ROUTE SYSTEM

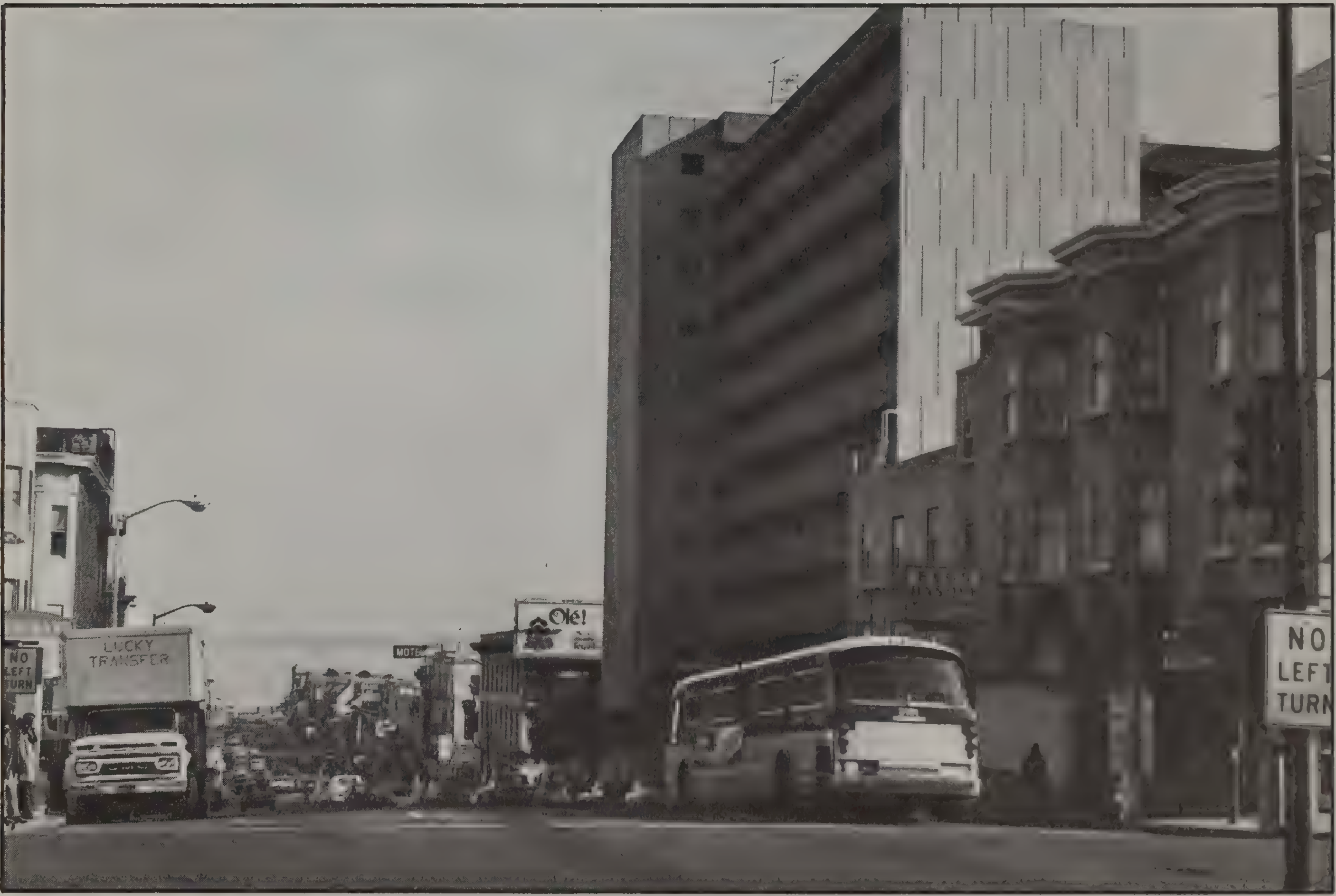
KAISER ENGINEERS

PARK PRESIDIO BOULEVARD AT CLEMENT STREET

CALIFORNIA STREET AT 10th AVENUE



LAGUNA STREET AT SUTTER STREET



BROADWAY STREET AT POWELL STREET

street width and grades. Alternative alignments such as Webster Street should be looked at in detail if this route were to be implemented.

The Geary Street route would take 6.2 minutes longer to the Transbay Terminal than the service via The Embarcadero and the California Street route would take 7.3 minutes longer.

When the Lombard Street-Van Ness Avenue intersection or North Point Street becomes congested, a parallel route would be initiated south on Van Ness Avenue and through the Broadway Tunnel to Battery and Sansome Streets. Broadway is already carrying 1,800 vehicles in the evening peak hour and is operating at Service Level D. The travel time to the Financial District from the Bridge Toll Plaza via Broadway would be 24.8 minutes which is 2.2 minutes longer than existing service via North Point and Bay Streets. By implementing the Broadway route, the percentage of bus patronage to the Financial District would be reduced by about 2% because of the increased travel time. The increased bus patronage to the western section of San Francisco would balance the loss in bus patronage to the Financial District. Thus the patronage forecast for the dispersed route concept is about the same as the existing bus system. There would be no capital cost or increased operating cost associated with the fixed facilities for this service concept. There would also be no economic benefits.

2. Existing Environment

The dispersed route would operate on most of the major arterials and some local neighborhood streets in the northwest portion of San Francisco.

This alternative would utilize two wide travel corridors to the Financial District. One generally follows the North Bay alignment of the existing route and single surface route alternatives. The environmental setting of the North Bay alignments has been discussed previously and will not be repeated here.

The other corridor traverses portions of the Richmond and Fillmore residential neighborhoods and then joins the existing

Civic Center route to the Transbay Terminal. Since the existing environmental setting of the Richmond and Fillmore Districts is not covered in any other route alternative, the remainder of this section focuses on these two predominantly residential areas.

a. Richmond District

Routes through the Richmond District would use California Street and Geary Blvd. These streets are major and secondary arterials respectively. MUNI routes are located on both California and Geary streets with the latter having the highest bus volumes of any street in the city. Golden Gate special buses currently serve the Fireman's Fund Building located at California and Presidio Avenue.

Land use frontage on California Street is primarily residential with some neighborhood commercial and institutional uses interspersed. Frontage on Geary Blvd. is predominantly strip commercial with some residential and institutional uses interspersed. The major institutional use is French Hospital at Geary and 6th Avenue.

The California Street route segment between Park Presidio and Baker Streets traverses the Clement, Jordan Park, and the extreme western portion of the Western Addition residential neighborhoods. The Geary Blvd. portion of the route segment borders the Clement, Inner Richmond, Jordan Park, Lone Mountain, and Western Addition residential neighborhoods. Ten census tracts with a combined population of 54, 503 surround this segment of the route in the Richmond District. Median family income is $11, 303, an amount $800 greater than the City average. Compared to the City average a slightly lower percentage of families are below the poverty level. About 70% of the net acreage of this area is residential. Most commercial activity is found on Geary Blvd. and Clement and California Streets. Only 1% growth is forecasted between 1970 and 1990 for both population and employment.

b. Fillmore District

In the Fillmore District, buses would operate on the Pine/Bush one-way couple, Geary Blvd., and Laguna Street. Pine and Bush Streets are major arterials with predominantly residential

frontage. Primary frontage on this portion of Geary Blvd. is commercial and institutional. Institutional uses include such regional travel destinations as Kaiser and Mount Zion Hospitals, the Japanese Cultural Center, and St. Mary's Cathedral. MUNI operates an express bus line on Pine and Bush Streets currently.

The Fillmore District route segment lies within 11 census tracts, having a combined population of 35,971. Median family income in this area is $7,540, substantially lower than the city average of $10,503. The percentage of families with incomes below the poverty level (19.8%) is twice the city average of 9.9%.

The percentage of owner-occupied units in this area (8.7%) is a quarter of the city average. This area shows a higher degree of transience than the city as a whole. Compared to a 48% city average, only 37% of the population has lived in the same address five years or longer.

Approximately half the net land use acreage of this area is residential and approximately 13% is commercial.

Forecasted employment change between 1970 and 1990 is approximately 1% for the Fillmore Districts. Population in the Fillmore District is expected to grow approximately 9%. Much of this growth will be accommodated in proposed residential development in the Fillmore Redevelopment Area.

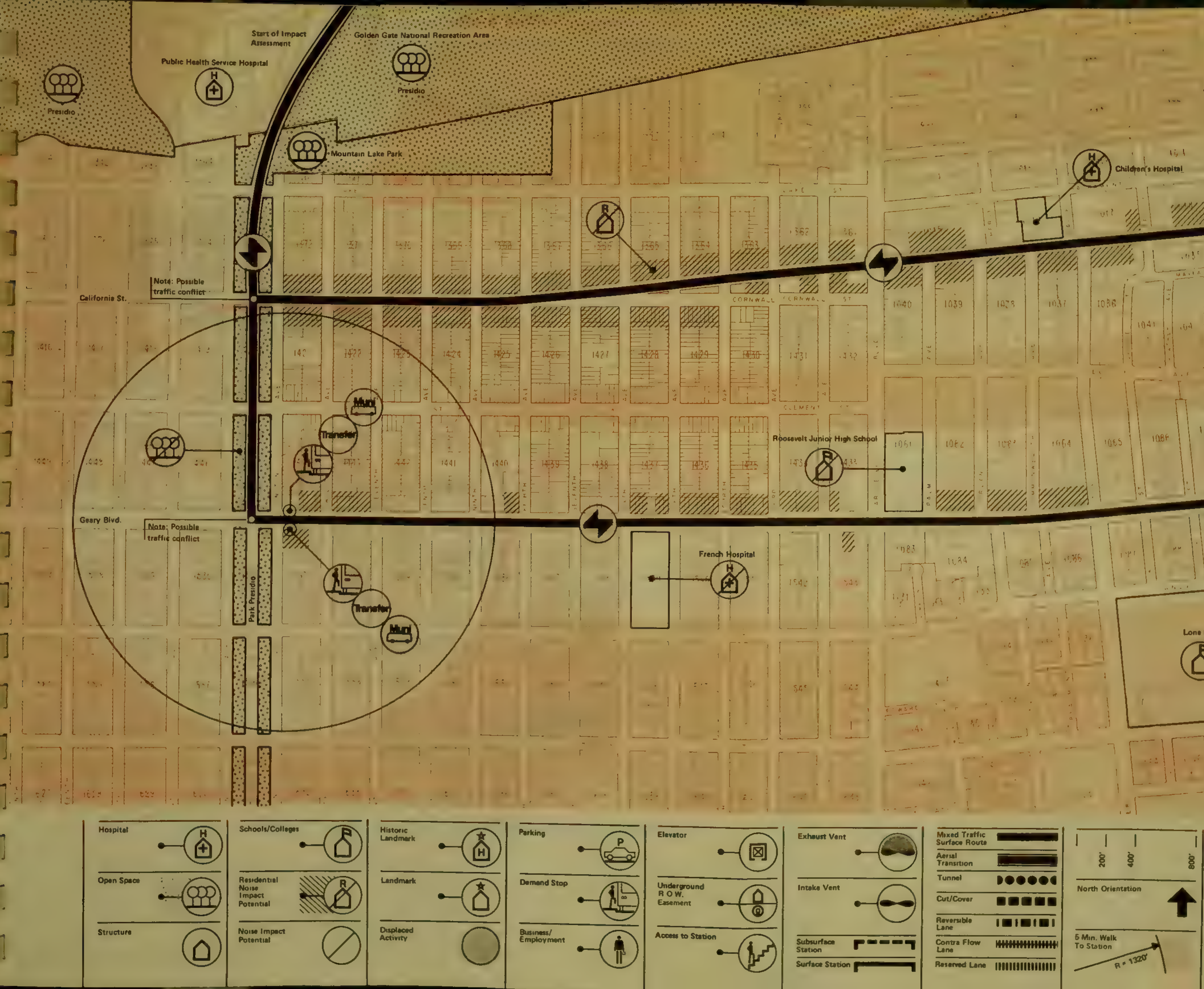
3. Impacts

The impacts on the urban environment resulting from the dispersed route concept are shown graphically in Figures V-47A and V-47B.

a. Disruption

There are no fixed facility improvements associated with this alternative; hence, there is no construction disruption.

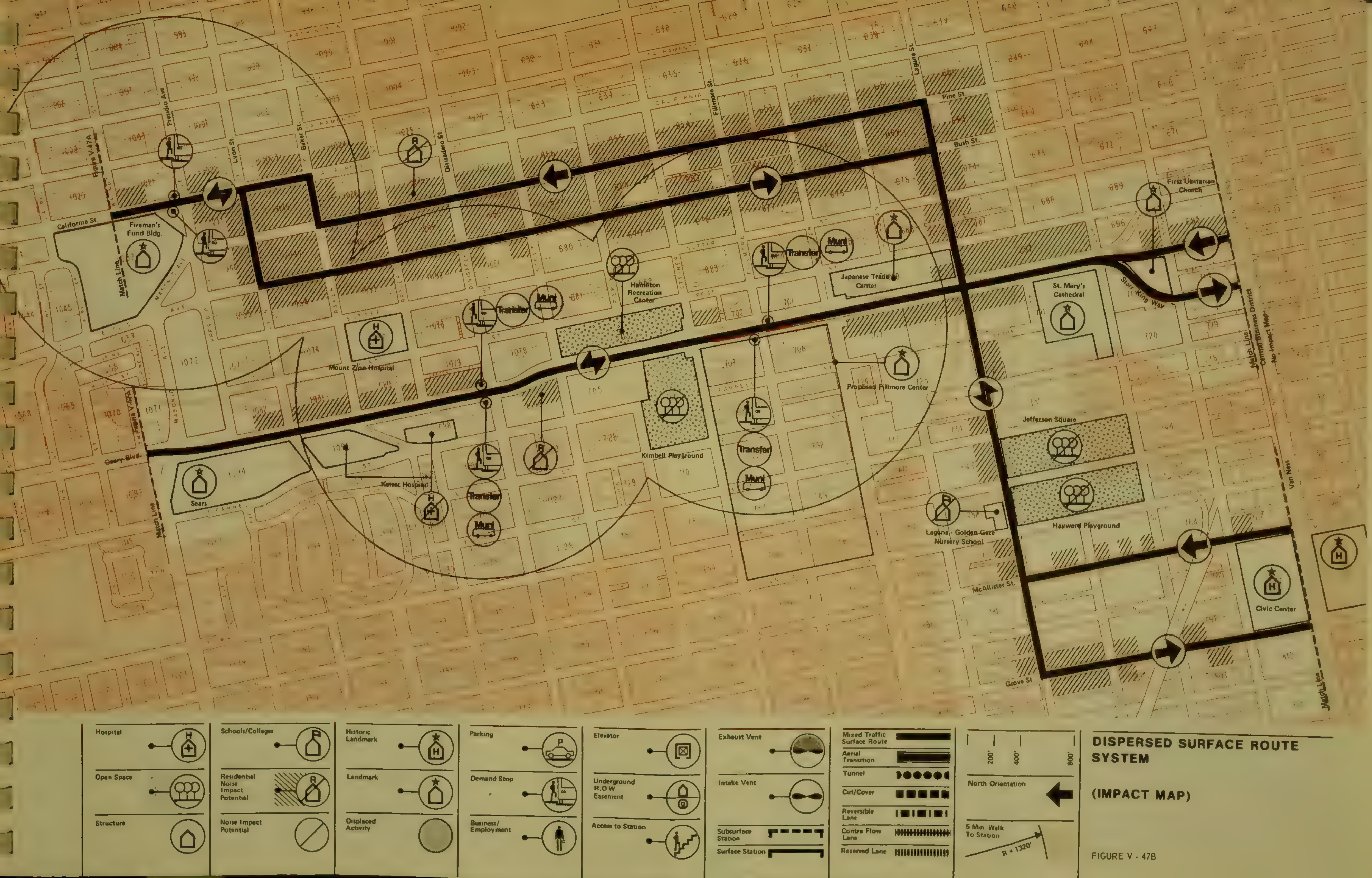
The major disruption will be the increased traffic disruptions, noise and safety hazards of putting buses on residential streets which now have no or low bus traffic.



DISPERSED SURFACE ROUTE SYSTEM

(IMPACT MAP)

FIGURE V - 47A



DISPERSED SURFACE ROUTE SYSTEM

(IMPACT MAP)

FIGURE V - 47B

The dispersed routes would increase the total number of residences potentially affected by noise along the Golden Gate bus routes from 4,849 on the existing route to 10,850. The areas most affected would be the sections of the route along Fifteenth Avenue, and Clement, Lake, California, Pine, Bush, Laguna, McAllister, and Grove Streets. The Children's Hospital on California Street and the residences on the steep grade on Laguna Street would be the most seriously noise-impacted areas. The Geary Street alignment currently has a high volume of traffic including buses and therefore the increased noise and safety hazards would not be noticeable to the surrounding areas.

b. Visual and Physical

The visual and physical intrusion of buses on the Richmond and Fillmore Districts will probably be most noticed on Lyon, Baker and Laguna Streets which heretofore have not had any buses operating on them. Even through buses will be operating on these streets only during a.m. and p.m. peak periods, the introduction of buses on these residential streets will change the character of these streets to some degree.

c. Land Use

The major land use impact on the dispersed route would be the provision of North Bay regional access to the proposed Fillmore Center. The availability of this additional amenity may be instrumental in advancing the development of this project which has been delayed for the past few years. The dispersed route will not increase or reduce parking land use consumption in the Financial District.

d. Accessibility

The dispersed routes would provide more accessibility for the San Francisco residents to the Golden Gate bus service than with the existing route. The number of residents within a five-minute walking distance of the bus stops for the existing route is 75,000; with the dispersed routes this figure increases to 97,000. This accessibility is applicable for reverse commuters and for recreational trips to Marin, as well.

4. Fact Sheet

A summary table comparing the dispersed route system with the existing bus operations in mixed traffic is on the following page. The data on this table are based on the general assumptions and factors described in Section VA, and the description and analysis presented in Section VD.

DISPERSED ROUTE FACT SHEET
(1990 Conditions)

Item	EXISTING SYSTEM	DISPERSED
Travel Time. From Toll Plaza to Financial District Station in minutes	28.6	30.2
Patronage. 1990 one-way, peak period		
-Bus riders	11,700	11,700
-Number of buses to financial district	97	71
-Total number of buses	147	147
-Auto reduction	0	0
Accessibility. Number of people within 5 minute walk of service in San Francisco		
-Employees	282,000	325,000
-Residents	75,000	97,000
-Transit dependents	31,000	38,000
Short-Term Impacts.		
-Construction disruption		None
-Construction employment in person-years		None
Long-Term Impacts.		
-Number of dwelling units along route	4,849	10,850
-Air pollutants (percent reduction)		None
-Fuel consumed(2)	142,500	142,500
-Traffic conflicts	Severe	Severe
Displacement.		
-Number of employees		None
-Number of businesses		None
-Number of parking spaces		None
Service Life. Approximate year congestion will degrade service below current level	1975	1975
Cost Data. (1975 dollars)		
-Capital cost		None
-Operating cost	3,700,000	3,800,000
-Annual $ benefits derived		None
-Incremental benefit/cost ratio		None

(1) Average travel time.

(2) Gallons of fuel used per day by buses and autos.

E. SUBAQUEOUS TUBE

The examination of the subaqueous tube alternative was not in the original scope of this study. This study was to be concerned only with that portion of the bus route within San Francisco. Previous studies of subaqueous tube alternatives connecting Marin County and San Francisco concluded that the tube was economically unfeasible. Also, the tube alternative has been strongly objected to by the Marin County residents as having a significant development impact on Marin County.

However, due to the renewed interest in a transbay tube by San Francisco citizens, the tube has been investigated in this study. Since the tube investigation was outside the scope of the study funded by UMTA, the work was done under a separate agreement with the Board of Control. The Metropolitan Transportation Commission conducted the urban, environmental and economic impacts of the tube. Their findings are included herein.

1. Route Description

The subaqueous tube alternative, shown in Figure V-48, would begin at Highway 101 just south of Richardson Bay Bridge in Marin County and terminate at the Transbay Terminal in San Francisco, a distance of 9.8 miles.

The alignment of the subaqueous tube was designed to completely bypass the city of Sausalito by extending the tube north in Richardson Bay. The tube was also planned to minimize construction disruption in San Francisco by placing the southern terminus of the tube east of Fisherman's Wharf. The route was designed also to be convertible from an exclusive busway to a fixed guideway.

The Marin approach to the tube would be located on the Northwestern Pacific Railroad right-of-way along Highway 101, and connect to Highway 101 over existing ramps located south of the Richardson Bay Bridge. Proceeding south, the busway would be at grade for a short distance and then descend into the tube portal located on a small spit of land projecting from the Richardson Bay shoreline approximately 1,000 feet south of the Marin County Heliport. The tube ventilation structure and the tube portal would be located to the northwest of the Sausalito city limits.

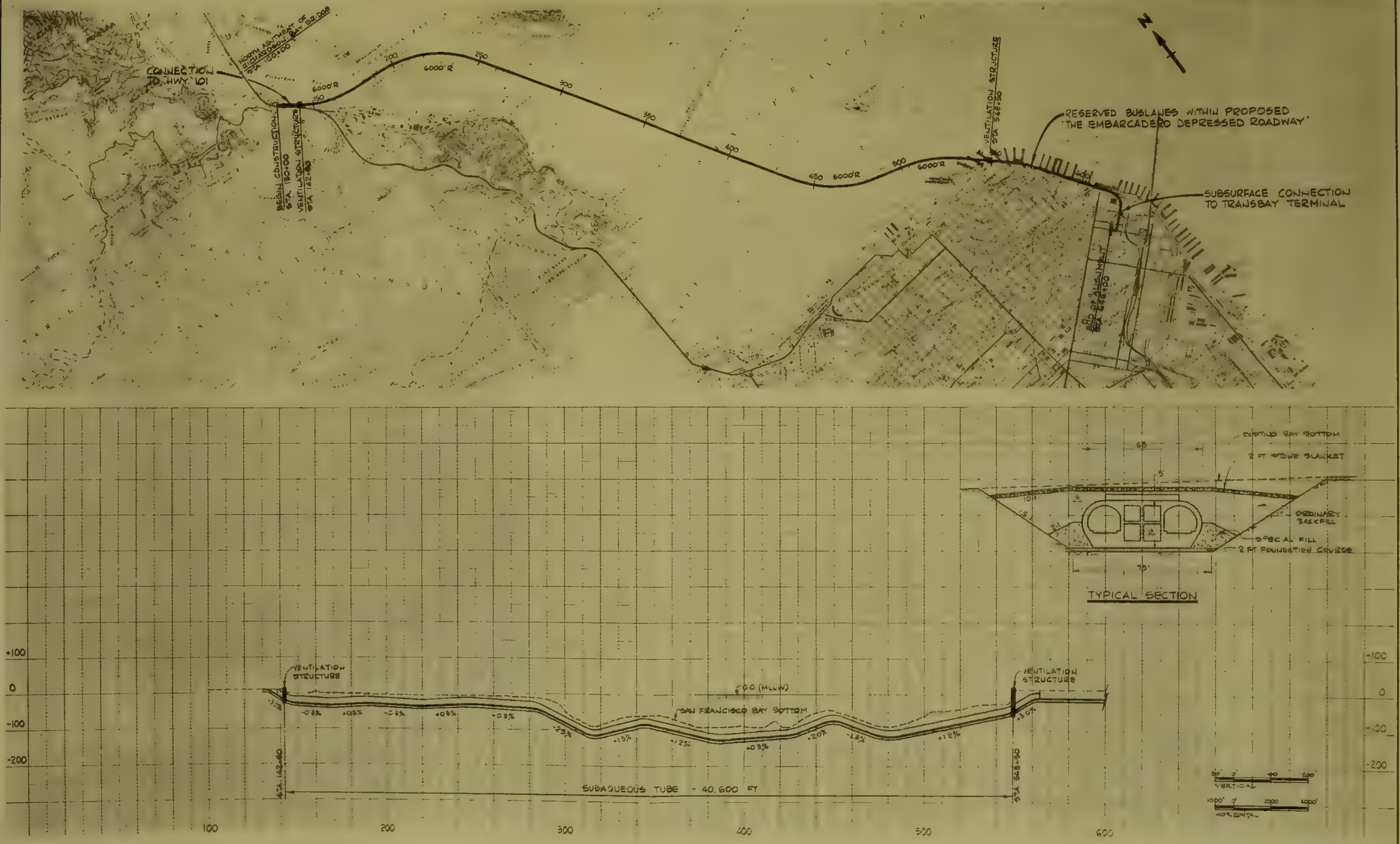


FIGURE V 48

SUBAQUEOUS TUBE

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If future conversion to fixed guideway occurred, the route could continue north in Marin County from the tube portal along the Northwestern Pacific Railroad right-of-way and then over Richardson Bay on a new bridge parallel to the existing Highway 101 Richardson Bay Bridge.

Proceeding south from the Richardson Bay tube portal, the route would leave the shoreline and go to the middle of Richardson Bay. A portion of Kappas Yacht Harbor would be penetrated by the route. This facility, however, could be restored after the tube is in place. Opposite Sausalito Point, the route would curve slightly west to approach an alignment passing to the west of Harding Rock, Arch Rock, and Alcatraz Island. This alignment is chosen to minimize amount of cost of rock excavation in the Bay bottom.

The tube itself would end at the foot of Pier 37 on the San Francisco waterfront. Piers 37 and 39 would both have to be removed.

The vertical profile of the subaqueous tube route would follow generally the Bay contour as shown on Figure V-48.

From the foot of Pier 37, the route would proceed south to join a transit right-of-way in an extension of the subsurface Embarcadero roadway proposed by San Francisco Department of City Planning.

Access from the Embarcadero to the Transbay Terminal would be provided in conjunction with a new Transbay Terminal.

2. Tube Structure

The subaqueous tube portion of this alternative would be constructed on the basis of techniques used to construct the BART transbay tube. Tube sections, averaging 330 feet in length, would be fabricated of reinforced concrete encased in the continuously welded steel plate. These prefabricated tube sections would be floated to surface locations above their ultimate positions, then sunk and successively assembled in a trench excavated in the Bay floor, and covered with protective layers of gravel, sand and stone. There is evidence of bedrock at elevations opposite Arch Rock which would require excavation. Rock contours would be no closer than 20 feet to the tube.

The proposed subaqueous tube would be 7.7 miles long and consist of two single lane, 19 feet-4 inch diameter tunnels separated by ventilation galleries. Details of tube section and installation in the Bay bottom are shown in Figure V-48.

The subaqueous tube structure is designed to accommodate conventional bus vehicles while allowing for future conversion to a fixed guideway system. It is substantially larger in diameter than the BART tube. The main reasons for the larger diameter are the ventilation requirement for diesel-powered buses and the length which is almost twice as long as the BART tube. Dual-powered vehicles would not significantly reduce the required size of the tube since fire hazard ventilation requirements are the determining factor, and dual-powered buses would carry highly combustible fuels.

3. Cost

The capital cost estimate for the subaqueous tube alternative is $690 million. This amount is expressed in 1975 dollars and is not escalated to the construction period. The tube and vent structures are estimated at $659 million, the Marine approach at $5.6 million, and the San Francisco approach at $25.7 million. The cost estimate does not include the work which would be done in conjunction with the improvements on the Embarcadero roadway, the Transbay Terminal, or a distribution transit system from the Transbay Terminal.

In addition to the capital construction cost, there would be annual operating cost for maintenance of the tube facilities and for electric power for the exhaust and lighting systems.

4. Service Considerations

a. Travel Time

Buses would travel at 50 mph for most of the 9.8 mile length of the subaqueous tube alternative. The travel time would be 14 minutes from Marin City to the Transbay Terminal. This would be a savings of 19 minutes over the current bus travel times, and 8 minutes saved over the subsurface alternatives. The 1990 additional patronage attracted compared to exclusive busway via the bridge would be about 5% or 750 additional bus

riders resulting in about 15,800 daily commuters. This increase assumes a very high transit service to distribute passengers to the Financial District from the Transbay Terminal. If this distribution service were not provided, the relative increase in patronage would be significantly lower.

b. Transit Accessibility

The tube alignment would unfavorably affect transit accessibility to the Civic Center and Western San Francisco for the 28% of the Golden Gate bus riders now reaching these destinations. With the tube these trips would require a transfer to MUNI or BART.

The tube alignment would not provide convenient access to the residents of San Francisco for reverse commuting or for recreational trips. The tube does not serve the residential areas of the City nor the recreational area south of the Marin tube portal.

The Following Italicized Sections
Were Prepared by the
Metropolitan Transportation Commission

5. *URBAN IMPACT*

a) *Displacement*

There appears to be little probability for significant displacement of either residential or commercial enterprise in Marin County to facilitate construction of the tube. If one assumes that work on an Embarcadero depressed roadway in San Francisco were undertaken prior to or concurrent with construction of the tube, then the commercial displacement of activities at Piers 37 and 39 would be insignificant, compared to the corresponding impact on the rest of the port and related activities along the northern waterfront. At any other time, the construction of the San Francisco approach could be closely integrated with the suggested redevelopment of the entire northern waterfront.

b) *San Francisco Neighborhoods*

The construction of a subaqueous tube providing a transit link from Marin County to San Francisco would have positive effects on San Francisco neighborhoods for a short while after the tube opened. These short-term positive effects would stem from the fact that fewer cars and no buses would be filtering from the Golden Gate Bridge to various CBD locations in San Francisco. But, as can be seen in other transportation corridors in the San Francisco Bay Area, any short-term effect from having fewer cars because people are switching to transit is soon nullified as more cars fill in the void caused by those people who switched to transit until congestion reaches a point at which the convenience of transit considerably exceeds that of the auto.

There is a way, though, that the positive effects on San Francisco of having the tube could be made long term and not just short term. If, at the same time the tube was opened, lanes on the Golden Gate Bridge were permanently closed and the capacity of approach streets in San Francisco were reduced, then the congestion on the Bridge would help people to make up their minds to use the alternative, the tube. Putting a "throttle", so to speak, on a transportation link can only be done when an alternative is offered, and in this case, the alternative would be the subaqueous tube. As no GGBHTD buses would be using the Bridge, if the tube existed, only auto drivers would be affected by the lowering of accessibility over the

Bridge. Because of the growth implications of the tube on Marin and Sonoma Counties, it would be crucial that the transit link provided by the tube provide good accessibility to and from San Francisco at all hours and on weekends.

c) Development Potential

As indicated above, the principal (if not sole) development potential to be achieved through implementation of the tube proposal is the redevelopment of the northern waterfront. However, that potential would only favor San Francisco proper, since the tube approach would not afford access to any point in San Francisco except the Transbay Terminal.

The MTC ran PLUM, a regional land use development model, with the Transbay Tube access time to San Francisco from Marin and Sonoma Counties. The model output indicated an 84% increase in growth in Marin County and 57% increase in growth in Sonoma County between 1970 and 1990. These changes in growth are compared to growth with only surface improvements to the bus systems.

d) Conformance to Planning Policy

In the sense that the tube would avoid encroachment upon/within/beneath Sausalito as well as provide impetus toward northern waterfront redevelopment in San Francisco, it could be said that the concept is in conformance with local planning policy. In terms of regional policy, the tube proposal doesn't offer the extensive transportation advantages needed to offset the large capital cost. The tube is duplicative of present service afforded through the soon-to-be expanded GGBHTD ferry operations. The tube also reinforces the suburban dormitory role now played in Marin County for San Francisco based employment. The growth that is acceptable to Marin County as defined by the Marin Countywide Plan would not establish travel demand to San Francisco which could justify a high capacity link such as the subaqueous tube.

6. ENVIRONMENTAL IMPACT

More than one mile of the tube alignment traverses the Mount Tamalpais Game Refuge in Richardson Bay. Dredging, segment placement, and backfilling operations could extend over such time duration as to significantly impact the viability of this habitat for wildlife and fish. Other impacts would be minimal and of short-term duration, principally limited to the construction period.

7. ECONOMIC IMPACT

The economic impact of the proposed project would be considerable. The combined 10-year transportation improvement program for the 9 county Bay region is estimated at approximately 4 billion 1973 dollars. The entire amount of these expenditures are for committed and planned projects. However, these funds would only allow for constructing one out of a possible six future BART extension projects during the 10-year period. This brief analysis of the economic impact of the proposed facility is concerned with 3 factors:

1. *The magnitude of the costs for the proposed facility relative to the 10-year transportation improvement program for both highway and public transit.*
2. *The potential diversion of scarce funds from currently planned and committed projects.*
3. *The distribution of costs and benefits between users and non-users.*

The 710 million dollar cost estimate amounts to 18% of the 10-year transportation improvement program. However, this cost does not include the construction of either the subsurface connector to the transbay terminal or the Embarcadero depressed roadway. Since these projects are not presently included in the 10-year transportation improvement program, at least 100 million dollars would have to be added to the cost of the subaqueous tube project, raising the total cost to over 800 million dollars, or 20% of the 10-year transportation improvement program.

The second point concerns any proposed diversion of regional transportation funds from existing and committed projects to finance the proposed tube. If the cost of the project is entirely born by users, i.e., tolls and property and/or sales tax assessments to San Francisco, Marin, and Sonoma County in proportion to estimates of utilization; this would not affect the 10-year transportation improvement program. However, there would be an opportunity cost of foregone additional projects in these areas that could be constructed if the tube were not built.

If funds from either Federal or State transportation sources earmarked for the Bay Area are used there would be a direct impact on the 10-year transportation improvement program. Since approximately 400 million dollars are budgeted each year (10-year average), the programming of funds for the tube would either have to be delayed, resulting in increased escalated cost, or dropped.

The third point concerns the distribution of costs and benefits of between users and non-users of the facility. The key factor is an estimated 22 minutes time saving over the existing Golden Gate Bridge trip and the incidence of this benefit vs. the incidence of cost. Again, if the proposed facility were financed totally by users then the incidence of costs and benefits would be equalized over the same group of people. However, ridership forecasts and population and employment forecasts of San Francisco, Marin, and Sonoma Counties indicate that if the facility were to be funded by regional funds, i.e. funds that could be spent throughout the region for transportation projects, the direct benefits would at best primarily accrue to only approximately 20-25% of the region's population.

Accordingly, the economic impact of cost of the route depends primarily on its financial structure. However, the benefits of the project, because of its specialized modal characteristics, would accrue to only a small group of the region's population.

8. FACT SHEET

On the following page is a summary table comparing the tube alternative with the existing bus system for 1990 conditions. The data on this table are based on the general assumptions and factors described in Section VA and the description and analysis presented in Section VE.

SUBAQUEOUS TUBE FACT SHEET

(1990 Conditions)

Item	EXISTING SYSTEM	SUBAQUEOUS TUBE
Travel Time. From Highway 101 Junction at Marin City to Transbay Terminal in minutes	39	14
Patronage. 1990 one-way, peak period		
-Bus riders	11,700	15,800
-Number of buses to financial district	97	-
-Total number of buses	147	198
-Auto reduction	0	3.150
Accessibility. Number of people within 5 minute walk of service in San Francisco		
-Employees	282,000	87,500
-Residents	75,000	200
-Transit dependents	31,000	200
Short-Term Impacts.		
-Construction disruption		Moderate-to-Severe
-Construction employment in person-years		Over 10,000
Long-Term Impacts.		
-Number of dwelling units along route	4,849	None
-Air pollutants (percent reduction)		6.1
-Fuel consumed(1)	142,500	8,900 Less
-Traffic conflicts	Severe	None
Displacement(2)		
-Number of employees		1,262
-Number of businesses		77
-Number of parking spaces		None
Service Life. Approximate year congestion will degrade service below current level	1975	Not Applicable
Cost Data. (1975 dollars)		
-Capital cost		690,000,000
-Operating cost	3.700,000	Not Developed
-Annual $ benefits derived		Not Developed
-Benefit/cost ratio		Not Developed

(1) Gallons of fuel used per day by buses and autos

(2) Further study required. Displacement depends upon route configuration on the Embarcadero to the Transbay Terminal. Assumed alignment would displace one hotel with 48 residents and as shown.

F. JOINT USE FACILITY IN THE NORTHWEST CORRIDOR

In November 1972, a Board of Control consisting of the City and County of San Francisco, the Bay Area Rapid Transit District, and The Metropolitan Transportation Commission initiated the Northwest San Francisco Rapid Transit Extension study (NWX). The objective of this study was to develop a comprehensive plan for improved transit facilities in the Geary Corridor including a rapid transit extension connecting to downtown San Francisco and the BART system.

The NWX Study and this Golden Gate Corridor Study jointly examined the possibility of combining local Geary Corridor transit service with the Regional Golden Gate transit service.

There are basically two alternative concepts to utilize joint facilities in the Corridor, these are a shared subway facility and a Golden Gate passenger transfer to an NWX rapid transit system.

1. Shared Subway Facility Concept

This concept envisions the two systems using the same facilities. This can be accomplished either by a double-deck subway, similar to the BART/MUNI Market Street subway, or by utilizing the same right-of-way (single-deck subway).

The double-deck subway would not require compatibility of transit vehicles. Since the right-of-ways would be separate, rail rapid transit would operate on one and bus transit on the other. The expected advantage of the double-deck subway would be minimized construction disruption and reduced capital cost.

The single-deck subway, while less expensive than the double-deck, must have compatible vehicle systems. The Golden Gate transit system is planned to remain a bus system. Therefore, this concept is only compatible with a local bus system in the Geary Corridor. The operation of local and express buses in the same level subway does present some undesirable operating and safety characteristics.

The NWX rapid transit system was designed to be constructed by tunnelling methods as opposed to cut and cover methods. The cost to combine the two transit services in a double level right-of-way using tunnelling does not generate any major cost saving. The cost of including Golden Gate transit service in the NWX corridor would be approximately equal to, if not more than, the cost of constructing a separate facility. For this reason, the Board of Control substituted the transfer concept for the shared subway concept.

2. Golden Gate Corridor Transfer Concept

This concept would have Golden Gate passengers transfer to the NWX transit vehicles. The NWX service has to provide local and express service. The express service would be required in order not to degrade the level of transit service from that which Golden Gate is currently providing. The transfer station shown in Figure V-49 would be at the intersection of Geary Blvd., and Park Presidio Blvd. The Golden Gate buses would travel over Park Presidio to reach this station. The existing roadways from Doyle Drive to Geary Blvd. could absorb the current bus load during the peak period. Increase in traffic would eventually require reserved bus lanes from Doyle Drive along Park Presidio Blvd. to the underground station at Geary Blvd. resulting in major construction costs and impacts.

A major disruption would occur to the surrounding neighborhood during the construction of this transfer system. Golden Gate buses would probably continue to provide bus service over the existing Civic Center route.

3. Results

The NWX study has concluded that both the short- and long-range transit improvement in the Geary Corridor should be an improved surface bus system. There is no facility planned for the Geary Corridor which the Golden Gate transit system could share. Therefore, the Board of Control deleted this alternative from the study.

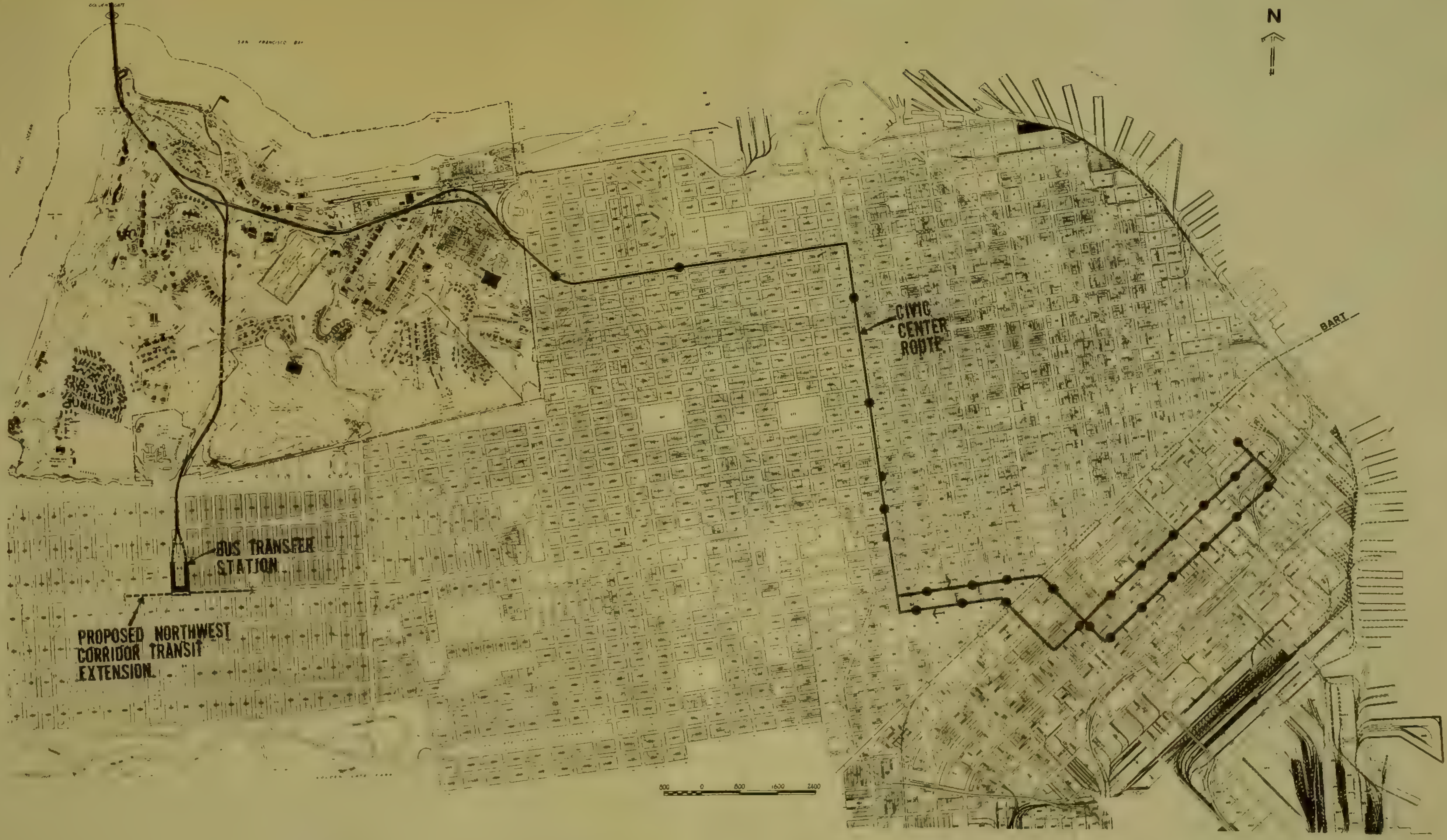

FIGURE V 49

JOINT USE CORRIDOR TRANSFER ALTERNATIVE

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VI. CONCLUSIONS

The Golden Gate Bridge, Highway and Transportation District (GGBHTD), in its 1971 Transportation Facilities Plan, identified that portion of its transit system within the City of San Francisco as the area with the highest priority for major improvements. The purpose of this current study is to develop and analyze route alternatives that would improve the Golden Gate transit service within San Francisco. The GGBHTD will develop a phased transportation plan partially based on this study. The objective of the GGBHTD is to develop a plan that offers the best opportunity for improving transit service with the least negative impact on local neighborhoods.

Throughout the course of the study the following items have become apparent as the key issues concerning transit route improvements in San Francisco:

- Transit Service--What does the alternative offer in the way of improved transit service? How well does it serve the destinations of the Marin/Sonoma commuters and nonwork travelers? How well does it serve the reverse commuter, the off-peak user and the recreation patron going to Marin/Sonoma from San Francisco? How well does it interact with other transit systems such as MUNI and BART?

- Impacts--What impact does the alternative have on San Francisco neighborhoods--short term and long term? What impact does the alternative have on Marin/Sonoma population and employment growth?

- Costs and Financing--What are the cost of the improvements and who will pay them? What are the federal, state and local funding sources available?

- Implementation Strategy--When are the improvements needed to maintain present level of bus service? When do the decisions and commitments concerning the selection of alternatives have to be made? How long will each alternative be effective and how flexible is it to meeting future demands?

A. TRANSIT SERVICE

One of the principal objectives of the study is to improve transit service and thereby attract more people from their automobile to transit. The San Francisco transit route improvements can affect transit service in four ways:

- Improve service for Marin/Sonoma residents traveling to San Francisco.
- Improve service for San Francisco residents traveling to Marin and Sonoma Counties.
- Improve intersystem transfer between the Golden Gate bus system and other transit systems.
- Improve local San Francisco travel through joint use of the improvements by MUNI.

1. Travel from Marin and Sonoma to San Francisco

The principal benefiters and users of the route improvements would be the commuters from Marin and Sonoma Counties.

The criterion developed during the study concerning transit service states that at least the current level of bus service shall be maintained. Even with the most conservative assumption of low population and high employment growth in Marin and Sonoma Counties, and low employment growth in San Francisco, auto use in the Golden Gate Corridor will continue to increase. Increased auto traffic will degrade the service level offered by the existing bus system which operates in mixed traffic on streets in San Francisco. Therefore, the "do-nothing" alternative is not a viable alternative for an extended period of time.

2. Travel from San Francisco to Marin and Sonoma

The number of residents within a five-minute walk of the alternative bus route stops is used as a measure of the service level provided to the travelers from San Francisco to Marin and Sonoma Counties. While there are some reverse commuters included in this group most of this travel occurs during nonpeak periods. Thus, very few of the San Francisco to Marin and Sonoma travelers would be affected by the surface route improvements.

The dispersed route concept does increase the number of residents within the five-minute walking access to Golden Gate bus service by 30% over the existing system. However, the flexibility to operate in a dispersed route concept to serve recreational or nonpeak travel to Marin and Sonoma exists with all alternatives.

The priority bus lanes on Lombard Street have the potential of being used during heavy travel periods on weekends and thereby benefit recreational transit travelers during these periods.

The subsurface alternatives are not as accessible for the San Francisco resident as the existing system. The Kearny subsurface route serves 13% fewer residents while the Battery route serves 20% fewer residents.

For the subaqueous tube the difference is even greater because of the express nature of the service offered. Only 200 residents are within a five-minute walk of the Transbay Terminal, which is the only access point for the system, compared to the 75,000 residents for the existing system.

The dispersed routes alternative offers accessibility to more employment locations especially in Northwestern San Francisco. However, service to the Financial District would be less than the existing system and because the dispersed surface systems would operate in mixed traffic on city streets, it would suffer the same service degradation as the existing system.

All single surface route alternatives would provide improved travel times and dependability as well as the attraction of convenient bus shelters.

Travel time savings over existing bus operations in 1990 would be 12 to 16 minutes. The most significant time savings would result from the Lombard tunnel improvement. The perceived single route improvements would be greater than the actual travel time savings as the buses would be operating freely on the reserved lanes compared to the auto traffic traveling in more congested conditions.

The subsurface alternatives would provide a 19-minute time savings in 1990 over the existing bus operation and offer the obvious dependability improvement gained with an exclusive, grade-separated busway.

The subaqueous tube alternative would provide the greatest improvement in travel time. The travel time savings from Marin City to San Francisco would be eight minutes more than the subsurface alternatives.

For the off-peak and weekend transit patrons from Marin and Sonoma Counties the service will be the same as the existing system for all the surface alternatives until the transit demand justifies the use of the reserve bus lanes during these periods. When this occurs, the surface alternatives with no major construction offer services to a greater number of destinations. The use of an alternative with all right-hand reserved lanes and no contraflow or reversible lanes would serve a larger number of destinations.

The subsurface alternatives and the subaqueous tube would provide the same improvements for off-peak and weekend service as they would during the peak period but would serve fewer destinations than the surface alternatives.

Service dependability of an alternative would be affected by vehicle reliability and the attendant disruption to service generated by vehicle failure. In the case of the surface alternatives, any bus vehicle failure in a reserved lane would disrupt service only for the period required to clear the bus lane. A serious auto accident blocking a reserved lane would be similar in disruption to a serious auto accident in mixed traffic service. A vehicle failing in the Van Ness underpass could be readily cleared in case of minor failures and towed clear otherwise, similar to the operation currently performed at the Waldo Grade Tunnel on Highway 101.

A failure in the Lombard tunnel could be cleared by pushing out one bus with another or towing as above. Because the tunnel is single lane, there would be temporary service disruption. A failure in the subsurface alternative would be managed as with the Lombard tunnel. Disruption would be approximately the same depending on how close the failure occurred to a station or other double-lane tunnel section. Failures in the subaqueous tube would be handled similarly but service disruption would be more severe.

Current failure and roadside repair data for the existing Golden Gate buses indicate that most failures are minor and do not prohibit a bus from continuing operation. Thus, in the case of most failures, a vehicle could clear its own way. Some vehicles are towed

because of total failures under current operations. However, this procedure is conducted as a maintenance safeguard to preclude further vehicle damage. The frequency of vehicle failures that require towing is not known, but a review of current maintenance information indicates no such failures have occurred within the past two years.

3. Travel Between Transit Systems

The surface route alternatives, including the dispersed alternative, would all have basically the same opportunities for intersystem transfer to MUNI and BART as the existing system. The single surface alternatives using the reversible lane on North Point Street (S2 and S6), the Van Ness underpass (S3 and S7), and the Lombard tunnel (S4 and S8) would have fewer opportunities for transfer to MUNI along the Northern water front area than the other surface alternatives. However, this difference in transfer capability affects less than 3% of the commute transit patrons.

The two subsurface alternatives would each have fewer transfer opportunities than the surface routes since they have fewer intermediate bus stops between the Bridge and the Financial District. The subsurface alternatives provide a more attractive transfer to BART than to the surface alternatives because of the underground pedestrian connection from the Financial District bus station to the BART station.

The subaqueous tube has the fewest locations for transfers because of its express service nature. If the existing Civic Center service were not continued, changes in the existing transfer locations would affect 25% of the commute transit patrons. The subaqueous tube route would provide the most direct service for transferring to the regional transit systems located at the Transbay Terminal. However, transfer to BART and MUNI would be much less convenient than with all the other alternatives.

4. Travel Within San Francisco

Although not the principal objective, the Golden Gate bus route improvements have the opportunity to improve transit service within San Francisco through the joint use with MUNI.

Joint use opportunities with MUNI would be available with all surface route alternatives. However, joint use with the dispersed alternative would be similar to the existing system and offers no significant advantage.

The opportunities for joint use would be nearly identical for the single surface route alternatives, differing only in the level of service offered. Most directly parallel to the alternative routes are MUNI's #30, #41 and #42 lines. The use of any of these alternatives by the #30 or #41 lines would require increased walking distances from the existing MUNI lines, but the improved service might compensate. The #42 line operates on Battery and Sansome Streets and would be able to use that portion of an improved route with no change in service.

However, there would be some disadvantages to joint use. The North Point reversible lane would allow only express service which would limit its use to the #30 Express MUNI line. Using North Point and Bay Streets as a one-way couple would require joint use but also require the installation of trolley wires, poles and feeders on Bay Street, and modification of the wires on North Point. This would generate an additional cost burden on MUNI as well as introduce a negative visual impact on Bay Street.

The Lombard tunnel offers the most improved service for MUNI in terms of travel time, but would again be limited to use by express buses.

The subsurface routes would provide very limited opportunities for joint use due to the difficulty of designing access and egress from the subsurface routes at points useful to MUNI without major disruptions and displacements to existing streets and buildings. The joint use opportunity with greatest potential would be in the Lombard-Russian Hill tunnel portion.

The subaqueous tube would not provide any joint use opportunities.

B. IMPACTS

1. Growth and Environmental Impacts

Marin County has adopted a low growth policy which reflects the Marin County voter attitude regarding maintaining the current environmental, recreational, and social balance in the county. Sonoma County is currently preparing its position regarding growth and plans to have a specific policy by mid-1975 as part of its General Plan. There is a variety of opinion within Sonoma County as to the proper balance between growth and lifestyle, but the tendency appears to be in the direction of lower growth than the present 4% per annum. In any event, regardless of the growth philosophy held, Sonoma County does not want to be a San Francisco employment bedroom community.

Further, all three counties, Marin, Sonoma and San Francisco, are in consonance with the Association of Bay Area Government in their desire to maintain, or if possible improve, the environmental quality of the region through reduction of air pollution, energy conservation, and preservation of open space.

Neither the existing system nor the dispersed surface alternative would generate additional growth in Marin and Sonoma counties. However, they do not attract additional patronage from the auto to help reduce auto traffic and air pollution.

The single surface route alternatives would tend to induce some minimal growth in the northern counties because of their improved commute attraction. Each of these alternatives would generate reduction in air pollution and savings in fuel consumption because of their ability to attract more auto users than the existing system.

The subsurface alternatives would tend to induce a slight growth impact in Marin County because of the improved service. These alternatives would generate approximately three times the fuel savings and pollution reduction as the surface alternatives.

The subaqueous tube would tend to induce considerably more growth than any of the other alternatives and would also generate the highest fuel savings and pollution reduction. The implementation of this alternative would be in conflict with the Bay Conservation and

Development Commission policy regarding the use of a transportation alternative in the Bay when a surface alternative is available, and with Marin County's growth policy as defined in the Marin Countywide Plan.

2. San Francisco Neighborhood Impacts

a. Dispersed Surface Alternative

The dispersed surface alternative would reduce the loading of large numbers of buses on any given city street. However, by dispersing the buses, the reduction in the volume of buses would take place on streets that are heavily traveled arterials and the addition of buses would occur on already congested arterials or residential streets which currently have no bus traffic. The impact, then, would be no perceived decrease in noise or traffic impacts on the streets currently traveled by buses and a completely new impact on streets not currently traveled by buses.

For example, forecasting the existing system to 1990 shows a need for almost 300 buses during the peak period. All 300 buses would travel on Lombard Street using the current bus routes. Today, during the peak period, the comparable number of buses is 200. Using the dispersed alternative would halve the number of buses on Lombard Street and put 120 buses onto Geary Blvd. and 30 buses onto California Street. The reduction on Lombard Street would not be perceivable and the addition on Geary Blvd. would create no perceptible increase in noise and a slight impact on peak period auto traffic. The routing of 30 buses onto California, Lyon, Baker, Pine, and Bush Streets and 60 buses onto Laguna Street, streets that are mixed commercial/residential or primarily residential, would generate noticeable noise and traffic impacts. The existing system route passes 4,881 dwelling units while the dispersed route alignment passes 10,882 dwelling units.

b. Single Surface Alternatives

These alternatives have generally similar impacts. However, localized impact varies substantially depending on the route treatment in the Lombard Segment and in the Van Ness/Battery Segment.

(1) Lombard Segment

The reserved and the contraflow lanes would have different degrees of traffic conflict on Lombard Street. By using the right-hand traffic lanes for reserved bus lanes, the parking displaced, auto congestion generated, and parking access restricted would be severe. By reducing the availability of auto traffic lanes from three to two, traffic demand on Lombard Street would be over 30% above capacity during the peak period. The excess auto demand would use the natural alternative of the Marina causing traffic, safety, and environmental impacts to that neighborhood. The right-hand reserve bus lane would present a bus operations problem in making the left turn at Van Ness Avenue. The traffic safety impact of this operation would require preferential signaling for buses creating additional auto delay. Similarly, this operation would be required to and from the Van Ness underpass or the Lombard tunnel.

Use of the contraflow lanes would obviate these problems, as well as improve access to existing parking by removing buses from the peak period auto traffic flow. This is a positive benefit to the retail establishments that depend on parking for the convenience of the retail shopper. Conversely, the negative economic impact to these retail establishments using the reserved lanes could be as much as $5. 9 million in annual equivalent lost sales.

The transit improvement using contraflow lanes would not reduce auto usage whereas the use of Lombard Street as a "throttle" to reduce auto usage would be accomplished by using the right-hand lanes for the reserved bus lanes. Creating the same throttling condition on Richardson Avenue, Doyle Drive, or the Golden Gate Bridge would achieve the same reduction in auto usage and permit the better transit operations of the contraflow lanes on Lombard Street.

(2) Van Ness-Battery Segment

The choice between the two short-term improvements in this segment--the reversible lane on North Point Street or the reserved lanes on the North Point and Bay Streets one-way couple depends solely on the action of the City of San Francisco.

The use of reserved bus lanes on North Point and Bay Streets as a one-way couple would displace 51 parking spaces during the peak periods. This is not a sizeable number in itself but does represent a significant percentage in reduction of parking available on these streets. The impact on traffic and parking would occur primarily from making these streets a one-way couple. Using one lane on each street for buses merely aggravates the impact. Bay Street would experience an increase in auto traffic demand in the morning peak period which would exceed the capacity of the street unless one parking lane was completely removed to permit three lanes of auto traffic. Further, Bay Street is primarily residential west of Columbus Avenue and the addition of buses with increased auto traffic would increase noise impact.

In the case of North Point Street, the evening peak period traffic demand would increase by over 100%, overloading the capacity of the street and causing the removal of at least one parking lane during the peak period. This would, of course, create a parking shortage during the peak period.

The Bay/North Point route alignment would permit bus stops at Kearny, Taylor, and Hyde Streets and thus provide better access than the reversible lane on North Point Street.

The service improvements offered by using a reversible bus lane on North Point Street would be the same as with the one-way couple in terms of travel time and dependability. The three bus stops not served in this case affect only a small percentage of the commute transit patrons.

There would be no impact on parking on North Point Street due to the reversible lane. There would be a pedestrian conflict crossing North Point Street at Taylor which would affect pedestrian access to retail establishments. There is no traffic impact in the morning peak period because Bay Street is unchanged and the lane taken on North Point Street is a westbound lane. In the evening peak period, the capacity of North Point Street would be reduced, causing some auto drivers to use Bay Street.

Between 1985 and 1990 one of two fixed facilities would be required to extend the life of the single surface route system. The Van Ness Avenue underpass, used with the reversible bus lane on North Point Street, would extend the life of a single surface route alternative (S1, S2, S5, or S6) beyond 1990. The Lombard tunnel would extend the life of the single surface route much further than the underpass since it bypasses the congestion and relatively severe neighborhood impacts along Van Ness Avenue, North Point Street and The Embarcadero.

c. Subsurface Alternatives

The negative impacts on the neighborhoods generated by either of the subsurface alternatives are almost totally construction-oriented and therefore short term. The long-term impacts on San Francisco neighborhoods are mostly positive: greater reduction in air pollution; greater savings in fuel consumed; no noise or traffic impacts at the neighborhood level. The long-term negative impacts result from the displacement of businesses and employees. The Kearny subsurface route would take 42 businesses and displace 859 employees while the Battery subsurface route would take 26 businesses and displace 567 employees. This impact could be lessened for the Battery alternative depending upon the development of a new Transbay Terminal. The Kearney alternative would be the same regardless of action taken at the Transbay Terminal. Compared to the surface alternatives this is a significant disruption. The short-term impacts result from the severe construction disruption. These impacts were described in detail in Section V. The duration of the construction impact would be from 2-1/2 to 3 years.

d. Subaqueous Tube Alternative

The positive and negative impacts of this alternative on San Francisco would be similar in nature to the subsurface alternative impacts. However, the positive benefits, both long and short term, would derive not only from having no buses in the neighborhoods, but also from no construction impact, except along The Embarcadero to the Transbay Terminal. The short-term disruption caused by construction would be severe but localized in the area along The Embarcadero to the Transbay

Terminal with no construction disruption elsewhere in the city. The costs of construction impacts associated with the subsurface alternatives, as described in Appendix VII range from $63,000 to $95,000 annually. In a comparison between the subaqueous tube and the subsurface alternatives, these costs would accrue as equivalent annual benefits to the tube. The long-term negative impact is again related to displacement. This is the only alternative that would displace residents, one hotel and 48 residents. There would be 77 businesses and 1,262 employees displaced.

C. COST AND FINANCING

The feasibility of financing the alternative bus route improvements under study in this report depends on the following factors:

- The magnitude of capital expenditures required for each improvement or package of improvements.
- The impact of each alternative on bus revenues and operating costs.
- The projected revenues, expenditures and priorities for the GGBHTD.
- The availability and priorities of federal, state and local sources of capital funds.
- State and local sources of operating funds.
- Project priorities of the Metropolitan Transportation Commission.

1. Amount of Capital Funds Required

The capital cost estimates for the various alternatives are summarized in Table VI-1. For the purposes of capital cost analysis, it is assumed that all proposed improvements except those requiring tunneling would be implemented in 1975. All improvements requiring tunneling are assumed completed in 1985.

A very significant difference exists in terms of the amount of capital funds required for the various improvement alternatives. The improvements designed for current surface bus operations have relatively low capital costs. The least costly of these individual improvements, the Lombard Contraflow Lane, requires fewer capital funds than the purchase of a single new bus.

TABLE VI-1

CAPITAL COST ESTIMATES FOR ALTERNATIVE BUS ROUTE IMPROVEMENTS

Alternatives		Capital Cost in Thousands of Dollars(1)			
		1975		1985	
S1 -	Lombard Reserve	153			
	North Point Bay Couplet	203			
	Other Improvements (2)	1,200			
			$ 1,556		
S2 -	Lombard Reserve	153			
	North Point Reversible	299			
	Other Improvements (2)	1,200			
			$ 1,652		
S3 -	Lombard Reserve	153		153	
	Van Ness Underpass	6,388		15,090	
	North Point Reversible	299		299	
	Other Improvements (3)	1,151		1,151	
			$ 7,991		$ 16,693
S4 -	Lombard Reserve	153		153	
	Telegraph Hill Tunnel	23,550		52,430	
	Other Improvements (3)	1,151		1,151	
			$ 24,854		$ 53,734
S5 -	Lombard Contraflow	48			
	North Point Bay Couplet	203			
	Other Improvements (2)	1,200			
			$ 1,451		
S6 -	Lombard Contraflow	48			
	North Point Reversible	299			
	Other Improvements (2)	1,200			
			$ 1,547		
S7 -	Lombard Contraflow	48		48	
	Van Ness Underpass	6,385		15,090	
	North Point Reversible	299		299	
	Other Improvements (3)	1,151		1,151	
			$ 7,883		$ 16,588

TABLE VI-1 (Cont)

S8 - Lombard Contraflow	48		48	
Telegraph Hill Tunnel	23,550		52,430	
Other Improvements (3)	1,151		1,151	
		$ 24,749		$ 53,629
Subsurface-Columbus/Kearny		$273,000		$552,000
Subsurface-Battery		$284,000		$574,000
Subaqueous Tube		$710,000		n. a.

(1) Dollars shown are total costs to implement; including engineering, procurement, management, and contingency (See Appendix VII).

(2) Improvements consist of the Van Ness Reserve Lane, The Embarcadero Reserve Lane, the Battery/Sansome Reserve Lanes and bus shelter.

(3) Same as (2) but excludes the Van Ness Reserve Lane.

The surface route improvements without the Van Ness underpass on Lombard tunnel range in capital cost from $1.45 to $1.65 million. With the underpass, the cost would be $16.7 million and with the tunnel, $53.7 million. The estimated cost for the subsurface routes is $552 million for the Kearny alignment and $574 million for the Battery alignment. These estimates assume completion of tunneling and construction by 1985 with escalation at 10% per year. (No escalation total for the subaqueous tube alternative is available.)

It is evident that any alternative requiring tunneling could not be implemented without federal funding assistance. However, individual surface improvements could be implemented without federal assistance.

2. Operating Subsidy Impacts

The second factor for viewing the financial requirements of the improvements concerns their impact on required operating subsidies. The impact is twofold. First, reduced travel times attract patrons and increase fare revenue. Second, reduced travel times improve bus operations efficiency by increasing the number of buses which can make two trips during the peak period. Significant operating cost savings are possible as fewer buses are required to serve the same number of patrons. Comparative operating subsidy reductions have been estimated using 1975 dollars for the alternatives and are shown in Table VI-2.

It is evident that the surface route alternatives without the underpass or tunnel would generate sufficient reductions in operating subsidies in the first three operating years to recover the capital costs needed for their implementation. However, the savings in the subsidy are not significant for alternatives requiring tunneling.

3. Projected Revenues and Expenditures for the GGBHTD

The third factor considers the ability of the GGBHTD to finance all or a portion of the cost of the alternative under study. A financial projection made by the GGBHTD in April 1973 forecast that the Reserve Fund Balance would decline from $20,500,000 as of June 1972 to $4,828,000 as of June 30, 1977 given the current schedule of committed capital expenditures, anticipated SB325 (sales tax)

TABLE VI-2

ESTIMATED REDUCTION IN ANNUAL OPERATING SUBSIDIES OCCURRING FROM USE OF BUS TRANSIT ALTERNATIVES COMPARED TO EXISTING SURFACE SYSTEM

(In 1975 Dollars)

Alternative	1975	1990
1. Lombard Reserve North Point-Bay Couplet	$540,000	$ 950,000
2. Lombard Reserve North Point Reversible	$540,000	$ 950,000
3. Lombard Reserve Van Ness Underpass North Point Reversible		$1,100,000
4. Lombard Reserve Lombard Tunnel		$1,250,000
5. Lombard Contraflow North Point Bay Couplet	$484,000	$ 850,000
6. Lombard Contraflow North Point Reversible	$484,000	$ 850,000
7. Lombard Contraflow Van Ness Underpass North Point Reversible	-	$1,000,000
8. Lombard Contraflow Lombard Tunnel	-	$1,250,000
9. Subsurface-Columbus/Kearny	-	$1,000,000
10. Subsurface-Battery	-	$1,350,000

Note: Estimates include increased revenue of patrons attracted by the improvements at $2/day for 250 days/yr, and operating cost savings due to more efficient bus operations (See Appendix VII for details).

funds, expected operating deficits for the bus and ferry systems, operating maintenance expenditures for the Bridge, and Bridge revenues (based on a 50-cent toll).

Since this projection was made, changes have occurred in the Bridge toll, policies in the bus/auto modal split, and in all operating costs. Currently, a special study is underway to test the financial results of alternate toll policies and bus and ferry fares. The results of this study are expected to identify a set of fare policies which would alter the current financial projections.

In view of present capital commitments for completion of the bus-ferry project and continued escalation of all operating and maintenance costs, it is prudent to assume that the GGBHTD could fund the local 20% share of federal financing from reserves for the surface route alternatives only. The ability to fund the local share of the Van Ness underpass or Lombard tunnel from reserves would depend on the experience of the 75-cent Bridge toll and operating cost of the expanded ferry system.

4. Sources of Capital Funds

a. Federal

The Urban Mass Transportation Assistance Act of 1974 provided for approximately $11.8 billion in assistance for the six-year period beginning with fiscal year 1975 and ending with fiscal year 1980. About $7.8 billion of these funds are to be expended as capital grants. An additional $4.0 billion are to be distributed over the six-year period under a new program as either capital grants or operating subsidies.

Under the conventional capital grant program from $1.2 to $1.3 billion is expected to be available annually. The old quota system under which a single state could not receive more than 12-1/2% of the total in any given fiscal year has been dropped. This rule had not been a restricting factor for California, however, since no more than 11% of a single year's nationwide expenditure had been received in California.

However, over the first ten years of the UMTA capital grant program, the nine Bay Area Counties, under the jurisdiction of the Metropolitan Transportation Commission, received about

70% of the California allocation. If the nine-county area succeeded in obtaining between 40 and 50% of funds made available for California, between $52 million and $65 million could be assumed available under the conventional UMTA capital grant programs annually in the six-year period, beginning with fiscal year 1975.

The estimate is very imprecise since it is difficult to judge how past allocations influence future allocations. It is clear, however, that the requirements of Los Angeles and San Diego for capital funding are likely to be comparatively stronger in the current period than in the past. But even if the Bay Area's portion of total UMTA capital funds is assumed to decrease, it is still possible for total federal transit capital funds to grow beyond presently projected appropriations if additional funds are legislated as a corollary to energy conservation plans.

Currently, the GGBHTD is receiving about $39,000,000 under two capital grant programs for the $55,000,000 bus-ferry and bus acquisition projects. Recently, bus purchases have been 80% federally funded but initial funding occurred under a 2/3-federal share provision.

The new capital/operating subsidy grant program in Section 5 of the Urban Mass Transportation Assistance Act of 1974 provides approximately $4.0 billion for dispersal over the 1975-1980 six-year period. Beginning with $300 million in fiscal 1975, the program will reach $900 million by fiscal 1980. A specific provision of Section 5 requires that the monies be allocated one-half on the basis of population and one-half on the basis of population density. The nine Bay Area Counties could expect to receive about $138 million of these new funds according to present population projections. If all of these funds are channelled into capital grants, $172.5 million in projects could be funded with the added 20% local share. If the funds are all used for operating subsidies, a 50/50 federal/local sharing is required. Under this use, approximately $276 million in funds could be available over the six-year period for the Bay Area.

Marin County's share of these projected funds is estimated to increase from about $320,000 in fiscal 1975 to $961,000 in fiscal 1980. A six-year total of $4.2 million is projected. This compares to $10.6 million for the County of San Francisco and $1.8

million for Sonoma for the six-year period. The conclusion is that sufficient federal funds would appear to be available under conventional and new UMTA funding programs to make implementation possible for any of the surface route improvements.

b. State

A new state program also makes capital funds available for transit. SCA 15, amending Article XXVI of the Constitution of the State of California, and adopted by a majority vote in November 1974 (Proposition 5), authorizes the use of revenues accruing from motor vehicle fuel revenues and use fees for:

- Research and planning, construction, improvement, operation, and maintenance of exclusive public mass transit guideways and related fixed facilities.
- Research and planning, construction, improvement, operation and maintenance of public streets and highways, including related public facilities for nonmotorized traffic.
- Acquisition of property for public streets, highways and public facilities, and the administrative costs of such acquisition.
- Mitigation of the environmental effects associated with the construction and operation of public streets and highways and related public facilities for nonmotorized traffic on the construction and operation of exclusive mass transit guideways and related fixed facilities.

The above provisions of SCA 15 are interpreted to preclude the use of SCA 15 funds as local matching funds for the purchases of buses. However, it has not been determined that such funds cannot be used for the construction of busways or "guideways" made available to and used only by buses.

A preliminary estimate places the amount of SCA 15 available for the nine Bay Area Counties at around $175 million, but a final formula for determining the county split has not been determined yet. It is expected that from 5 to 15% of the amount would be available in the current fiscal year, from 10 to 20% in

1975/1976; from 15 to 25% in 1976/1977; and up to 20% in 1977/1978 depending on the amount deemed necessary to maximize federal assistance. Beginning in fiscal 1979, the maximum percentage made available would be 25. In addition to the rise in the percentage of funds made available, the future revenue base is expected to rise with gasoline tax collections and vehicle use taxes.

There is a further feature of SCA 15 funds of interest. Up to 25% of such funds can be used to service long-term debt provided voter approval is attained. Thus, there remains the possibility that the local costs for an exclusive busway could be financed with revenue bonds with interest and principal being met out of SCA 15 tax collection.

c. Local

Two local sources of capital funds can be identified. These are the use of property tax revenue and the use of sales tax revenue. Both types of financing are unlikely to be used in financing transit improvements under study. San Francisco voters already are lending financial support to both the MUNI and BART systems via the property tax and a one-half cent sales tax. The latter was imposed by the State Legislature and could possibly be extended to Marin and Sonoma Counties for transit operations. It is considered unlikely that voters in San Francisco would approve an increase in either property taxes or retail sales taxes for improving transit access to San Francisco for Marin/Sonoma commuters.

Voters recently have generally displayed a disinclination to increase property or sales taxes for financing public transit. Recognizing this trend, additional federal and state programs have been developed for both capital and operating funds. For these reasons, it is also believed that voter approved increases in sales and/or property taxes in North Bay Counties are not assumed to be a viable method for financing transit improvement serving citizens of these counties.

These conclusions regarding use of property and/or sales taxes mean that subsurface route alternatives under study would be difficult to finance without State legislative action. Meeting the local share, assuming 80% federal funding was available, would

almost certainly require issuing bonds backed by retail or property tax revenues. For this reason, it can be considered that the financing of subsurface improvements would be substantially more difficult than the surface improvements.

Other local (and state) actions can be identified. Special taxes might be levied on standard automobiles or second and third cars owned in a single household. Indeed, such a special tax in lieu of property taxes could be combined with other energy conservation measures concurrently in an integrated program to divert commuters from automobiles to buses or other means of public transport.

Similarly, special gasoline taxes might be utilized to discourage use of the automobile and encourage the use of public transit. Such a program, however, would likely require enabling legislation on the state level.

5. State and Local Sources of Operating Funds

Transit experts in the San Francisco Bay Area indicate that about $2 billion in capital funds, and $3.6 billion in operating subsidies will be available over the next 10 years for the nine Bay Area Counties. Their estimate is higher than the $4.6 billion total estimated by the Metropolitan Transportation Commission in 1973 and reflects new federal and state sources, including those reviewed above.

The new UMTA capital and/or operating funds program was discussed above. Marin County's share of the new program is expected to range from about $320,000 in 1975 to $961,000 in 1980. Some portions of this, as well as a possible share of San Francisco's and Sonoma's allocations, could be utilized by the GGBHTD as the federal share of projected operating subsidies when matched with funds available locally.

The principal source of "local" funds for operating subsidies derive from SB-325 or Transit Development Act funds (TDA funds). These funds, collected by the state, are generated by the allocation of one-quarter of one cent of the tax on retail sales to financing operating subsidies, and to a lesser extent, capital expenditures. Operating subsidies have been emphasized by the California Department of Transportation and the Metropolitan Transportation

Commission (MTC) as the area of greatest current need. The MTC, as noted, adjudicates use of TDA funds collected in each county among competing transportation improvement projects and competing transit agencies in that county.

Currently, the GGBHTD anticipates receiving $3.3 million for meeting bus operating deficits in the current fiscal year. This is expected to increase to $3.5 million by fiscal year 1977. By fiscal 1977, it is anticipated that $1.8 million in additional TDA funds will be required for ferry operations.

In addition, TDA capital funds of about $1.5 million are anticipated by the GGBHTD. It was noted earlier that the transit improvement packages permit both savings in bus operating costs and collection of increased passenger revenue. It was also concluded elsewhere in this study that no additional buses are required to accommodate the increase in patronage due to improved bus scheduling opportunities generated by shorter travel time. Thus, it appears that some TDA funds expected to be used for operating subsidies could be used as a source of the "local" share of capital funds needed for financing surface transit improvements under study.

The above projections were made before the current recession slowed the rise in retail sales activity, and therefore, available TDA funds. In the past, it has been assumed that such funds would increase at a rate of about 7.5% per year in the Bay Area. This growth reflects price inflation, population growth, and expected increases in real income and is likely to resume when the current recession terminates.

It is evident that TDA funds are likely to be the single most significant source utilized to match federal funds with "local" funds for either capital expenditures (80/20) or operating funds (50/50).

6. Priorities of the Metropolitan Transportation Commission (MTC)

As the chief planning agency empowered to develop an integrated transportation plan for the nine-county San Francisco Bay Area, the MTC is charged with the responsibility of ranking all alternative uses for transit improvement funds. Specifically, they are empowered with allocation of TDA or SB-325 funds rebated by the state to individual counties. Following policy guidelines of the California Department of Transportation, hard choices must also

be made between the use of TDA funds for capital expenditure vs operating subsidies. In addition, the MTC exerts considerable influence over UMTA funding decisions since TDA funds are used to maximum advantage when they represent the local share matching or supplementing federal funds.

It is evident, therefore, that implementation of any of the surface or subsurface improvements is certain to require the approval of the MTC. The analyses of benefits and costs, and the impact of those improvements on bus patronage, fare box revenues, and operating costs will be important factors utilized by the MTC in evaluating the merits of the various improvements under study in this report.

D. IMPLEMENTATION STRATEGY

1. Factors Affecting Timing and Duration of Improvements

There are four factors which could influence the time when the various improvements are needed and the length of time the improvements would maintain at least the present level of bus service. These factors are:

- Carpooling
- Increased Ferry Fleet
- Fuel Shortage
- Staggered Work Hours

a. Carpooling

Increased carpooling is an attractive alternative for reducing peak period congestion caused by Marin and Sonoma auto commuters. It is also an alternative means of transportation during an energy shortage. However, it is noted that auto occupancy rates on the Golden Gate Bridge of 1.2 to 1.3 persons per vehicle during the commute period remained essentially unchanged from November 1973 to March 1974, during the height of the gasoline crisis. Although total traffic volumes across the Bridge were down for this period, the nonvarying auto occupancy rates indicated an overall lack of interest in carpooling as an

alternative means of getting to work. This occurred despite a regionwide campaign to promote carpooling (the RIDES Program). Commuters who did decide to switch selected transit rather than a carpool. This is consistent with carpooling behavior noted in other areas wherein travelers in higher economic status are much less likely to carpool than lower income travelers.

Sonoma County commuters were an exception to the overall trend in the North Bay to switch to the bus. However, since the limited transit service in Sonoma County was already near capacity, there was little choice other than to carpool. Marin County residents, on the other hand, had unused capacity available on many routes and therefore increased their usage of the bus and ferry. Since Sonoma commuters make up a relatively small part of the commute across the Bridge, their total impact was minor.

In summary, carpooling was not utilized to any significant extent in the Golden Gate Corridor during the last energy shortage. It can be postulated from this behavior that it would take more than a period of three to five months of diminished gasoline supply to make carpooling a significant alternative. However, there are several situations which might spur ride sharing. Gasoline shortages that would last longer than six months with the possibility of lasting for several years would undoubtedly increase carpooling, particularly during the commute period.

Without an energy crisis there would have to be a decrease in either travel costs (over and above the savings of the passengers' driving cost) or in travel time to promote ride sharing. Reduced tolls for carpools on the Bridge would have relatively small impact on drivers, since tolls represent a small percentage of the total trip costs (i. e., parking, vehicle operation, and tolls).

Some form of preferential treatment that would reduce travel time for carpoolers compared to single occupancy vehicles has the highest impact in changing travel mode.

Examples of preferential treatment have been implemented in numerous locations throughout the country. This is normally done by reserving a traffic lane for carpools exclusively--or more usually for carpools and buses. Two examples of this are

the Shirley Highway serving Washington, D. C., and Northern Virginia and the San Francisco-Oakland Bay Bridge. The Bay Bridge differs from the Shirley Highway in that instead of reserving a highway lane for a long distance, it merely reserves an access lane to the Bridge toll booths and also reserves toll booths exclusively for carpools. It results in a saving of 10 minutes in the morning peak hour travel time, and from December 1971 until May 1972 was toll-free. After May of 1972, a monthly pass costing $1.00 per vehicle was required, and after March 1975 yearly passes were issued free. The results of the Bay Bridge experience are inconclusive. Before preferential treatment was begun, 1,000 cars with three or more persons used the bridge during the morning peak period. Within two months after the preferential treatment was initiated, the total carpools increased to 2,200. In May 1972 when the $1.00 monthly passes were required, carpooling decreased to 1,600 vehicles during the peak. It is doubtful whether the increase in cost to $1.00/month ($0.05/trip) caused this marked decline, but rather it was probably a combination of factors not the least of which was the inconvenience of having to get a pass once a month. It is interesting to note that during the last year, peak period carpooling on the Bay Bridge has not increased from an average of just under 2,000 per day in spite of the RIDES matching program.

A second type of priority treatment that is possible is in the area of parking. Preference could be given to carpool vehicles in both public and private parking lots. The EPA regulations on Air Quality which were due to go into effect this year had a very strong preferential system for carpooling. First, by giving preferential treatment to carpools, private firms would avoid a very large tax on parking spaces. Secondly, the carpool riders received preferential locations and reduced fees for parking. Such mandatory restrictions may have the largest impact on carpooling; however, as evidenced by the public and business opposition to such restrictions, they are very difficult to implement and monitor and are therefore currently being held in abeyance.

It can be inferred from the events of the recent energy shortage that it would take a more severe and long-lasting shortage before carpooling would be employed voluntarily by Golden Gate Corridor commuters. Even though a major effort was made to promote carpooling, it was relatively unsuccessful.

b. Increased Ferry Fleet

The Golden Gate Ferry service will increase its peak period capacity from 900 patrons to approximately 5,000 patrons with the delivery of three new ferries by the end of 1976. Golden Gate ferry patronage is expected to reach approximately 4,400 peak period patrons by the beginning of 1990 with service to Sausalito and Larkspur.

One alternative plan set forth to handle excess transit patronage in future years is to increase the capacity of the ferry system rather than the bus system. The major advantage of this plan is that it would eliminate the need for very expensive underground tunneling and grade separations. Substantial neighborhood disruptions, particularly in San Francisco, would result from these improvements.

Increasing the capacity of the ferry system will require a high capital investment. Additional ferries must be purchased, terminal capacities may have to be increased, and additional collector/distributor bus service will be required at either end of the ferry system. If the ferry system attempts to accommodate all increases in demand after the bus system reaches capacity substantial improvements will be required to facilitate intermodal transfers.

The current utilization of the ferry service is generally limited at the San Francisco end to those destinations that are within walking distance of the terminal. A large increase in ferry use will require some form of shuttle service to serve the destinations of the ferry travelers. In order to "compete" with the auto mode, the shuttle service will have to be low cost and the transfer time must be minimized. The transfer time is particularly critical in the modal choice decision since travelers perceive waiting time to be approximately 2-1/2 times longer than the equivalent driving or riding time. In terms of cost, the shuttle service ideally should be free, similar to the free transfers that exist now between BART and AC Transit.

On the Marin County end of the trip additional terminal and parking capacity will probably be required. Traffic and environmental problems will be encountered due to the increased commuter traffic in the vicinity of the terminals. Increasing parking and roadway capacities could be a major problem because of their impacts and the political attitudes in Marin County.

c. Fuel Shortage

The recent energy crisis which occurred from November 1973 to May 1974 produced significant changes in transit riding habits in the Golden Gate Corridor. Allowing for seasonal variations, it has been shown that as gasoline supplies were reduced, auto traffic went down and commute transit went up. According to data from the Bridge District (Table VI-3), peak period bridge traffic was reduced up to 16% during this period while transit ridership increased an average of 10 to 13%. This increase in transit ridership is in addition to the uniform increase that had been experienced by Golden Gate Transit in the months preceding the gasoline shortage. Most of the increased transit ridership was produced by Marin County residents rather than commuters from Sonoma County who tended to switch to carpooling rather than bus riding. It should be noted, however, that carpooling replaced low occupancy car use only in Sonoma County areas where transit was at capacity or nonexistent.

The two factors contributing to the decreased auto travel were the availability and increased price of gasoline during the energy shortage. It appears that gasoline availability or waiting in line was by far the more significant of the two. Commuters placed a higher emphasis on the cost of their time than on the gasoline cost increase.

To quantify the effects of a sustained fuel shortage, several items must be considered:

- Will auto drivers switch to smaller cars of lower gas consumption, using less energy but producing auto volumes as large as today?
- Will some technologically advanced vehicle replace the need for the internal combustion engine and gasoline?
- Will gasoline supplies become plentiful due to the discovery of a new energy source that can replace oil now used in some other sphere?

Only qualitative judgments can be made at this time regarding the answers to the above questions. Small car sales have increased over the past year and auto manufacturers have publicly

stated that they will be making billion dollar investments in retooling for small car production. Discussions are being held between auto manufacturers and the Federal Government to increase operating efficiencies from a current average of 13 miles per gallon to 18 miles per gallon. These actions may be adequate to overcome both price increases and reduced availability of gasoline. If this takes place energy consideration may play a very small role in modal choice over the long run. In the short run, another energy crisis and/or gas rationing program could have an immediate effect on transit demand.

Significant technological changes in replacing internal combustion engines is at least ten years away and even if they occur their full impact would not be felt for another five to ten years. There is a high probability that improvement of this type will occur faster in the transit and paratransit field than in the automobile field.

The development of alternative energy sources has become a national goal. However, this development will likely affect the consumer market in the same 10 to 20 year time frame as other technological advances.

TABLE VI-3

GOLDEN GATE CORRIDOR COMMUTE PATTERNS DURING THE ENERGY CRISIS

	Weekday Bridge Traffic	Commute Bridge Traffic	Transit Load Factors	Auto Occupancy Factor	Commute Period Transit Riders
Nov 1973	- 1%*	0%	88.1	1.31 (1.23)**	
Dec 1973	- 5%	- 2.9%	89.6	1.31 (1.23)	
Jan 1974	- 2.6%	- 3.2%	91.6	1.29 (1.31)	8499 (6950)**
Feb 1974	- 7.7%	- 4.7%	95.6	1.29 (1.29)	8860 (7204)
TOLL INCREASE					
Mar 1974	-19.5%	-16.4%	103.5	1.33 (1.27)	9670 (7275)

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* Change from previous year

**Figures are for 1972-73

PEAK HOUR TRANSIT PATRON COUNTS (7-8 AM)

	# Commute Riders	# Club Bus Riders	# Standees
1/13/75	4868	400	145
12/11/74	4752	357	135
11/ 6/74	4548	0*	224

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*Club Bus on Strike

Source: Golden Gate Bridge, Highway and Transportation District

d. Staggered Work Hours

The heavy commute periods in the Golden Gate Corridor extend from 7 to 9 a.m. in the morning and from 4 to 6 p.m. in the afternoon. Within these periods there exist sharp 20-minute peaks. The present Golden Gate Transit system and the existing auto traffic can be considered to be at an undesirable congestion level on the Bridge, Doyle Drive, and Lombard Street during the peak 20 minutes on most days and occasionally for an entire hour or longer.

In designing a transit system, the peak hour or the peak 20 minutes are the time periods which the maximum number of buses are needed. By planning for this short peak, the Bridge District is contending with a problem created by the relatively rigid working hours set by San Francisco business establishments. Should the starting and ending work times be staggered or made flexible, thereby lengthening the peak period, auto congestion would be reduced and a smaller number of buses would be required to handle the same number of patrons. The staggered work hours would eliminate sharp peaks and allow buses on the shorter runs to make two morning or afternoon round trip runs instead of one.

A serious program to stagger work hours would in the short run eliminate traffic congestion and the need for an expanded transit system. Also, improvements such as reserved transit lanes,

underpasses and transit tunnels would be delayed into the future. The drawback would be that over time, the use of the auto would increase due to less congestion on the roadway system and the air quality problem would be increased. Of course, at some point in the future even with staggered working hours, the roads could again reach their present congestion level because of natural growth of population and employment in the corridor.

For the purposes of analyzing the duration of system effectiveness of the alternatives, it is assumed that the conditions prevailing regarding the above factors will be as they are today. It is clear that the impact of any of these factors would be to change the time frame when each alternative would be needed and to change the duration of system effectiveness of each.

2. Course of Action

The decision diagram shown in Figure VI-1 presents an implementation sequence that uses the least cost alternatives first and moving to more capital intensive alternatives in the future in order to maintain the specified service level while maintaining the maximum flexibility for meeting future transit needs. The diagram shows the major implementation points. Each of these implementation points must have been preceded by the selection of an alternative.

The diagram flow begins with the existing bus system, showing it to be at the specified service level in 1975. As discussed above, any increase in congestion on city streets will degrade the existing service. The first implementation point is shown in 1975 and requires the choice between the dispersed surface alternative and those single surface alternatives that require no major construction (S1, S2, S5 and S6). The dispersed alternative is shown with a short duration of system effectiveness. As discussed above, this alternative is subject to the same service degradation because of congestion as is the existing system. By dispersing the buses onto a number of routes, the congestion impact would be lessened slightly and this alternative could function at or near the specified service level for a short period. Combining the dispersed alternative with a single surface alternative would have the effect of extending the duration of the alternative for a short period.

The next implementation point occurs when the selected alternative, or combination of alternatives, degrades in service to today's level.

SAN FRANCISCO PORTION - GOLDEN GATE TRANSIT SYSTEM

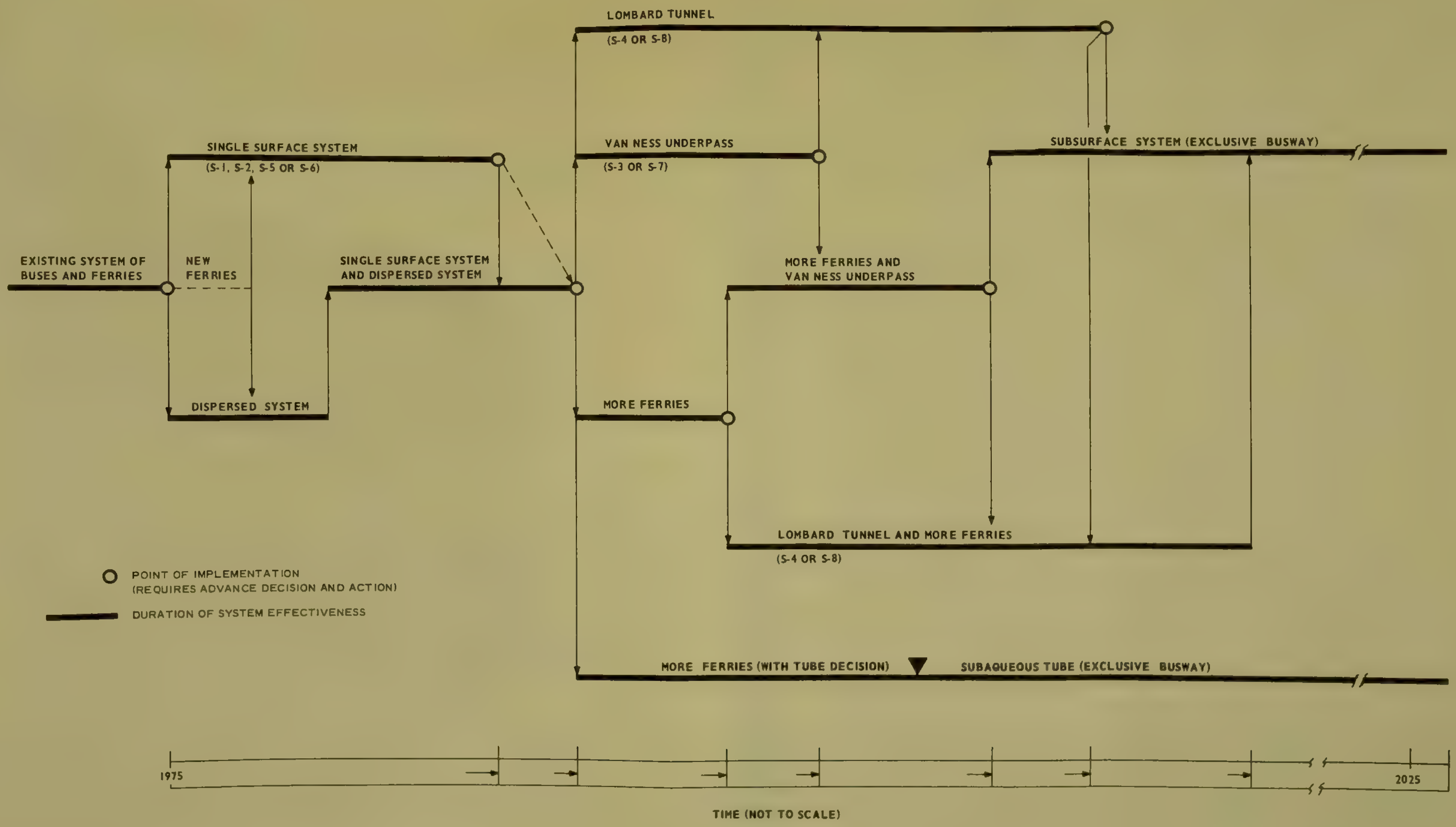
LOMBARD TUNNEL
(S-4 OR S-8)
VAN NESS UNDERPASS
(S-3 OR S-7)
SINGLE SURFACE SYSTEM
(S-1, S-2, S-5 OR S-6)
SUBSURFACE SYSTEM (EXCLUSIVE BUSWAY)
EXISTING SYSTEM OF BUSES AND FERRIES
NEW FERRIES
SINGLE SURFACE SYSTEM AND DISPERSED SYSTEM
MORE FERRIES AND VAN NESS UNDERPASS
DISPERSED SYSTEM
MORE FERRIES
LOMBARD TUNNEL AND MORE FERRIES
(S-4 OR S-8)
POINT OF IMPLEMENTATION (REQUIRES ADVANCE DECISION AND ACTION)
DURATION OF SYSTEM EFFECTIVENESS
MORE FERRIES (WITH TUBE DECISION)
SUBAQUEOUS TUBE (EXCLUSIVE BUSWAY)
1975
2025
TIME (NOT TO SCALE)

FIGURE VI - 1

DECISION DIAGRAM

KAISER ENGINEERS

The selected single surface alternative (S1, S2, S5 or S6) in combination with the dispersed surface alternative, has a duration of approximately 10 to 15 years. Forecasts for 1985 indicate that the required bus flow rate during the peak hour would be seriously impeded at two critical intersections: Lombard Street and Van Ness Avenue, and Bay Street and Van Ness Avenue. Adjusting the traffic signal timing to provide preferential treatment for buses would cause severe impact on auto traffic. Efficient flow at these two intersections is critical to traffic operations during the peak period. These two intersections are near their capacity today, and even with surface improvements for the buses, the selected alternative would experience a degradation of service.

The next implementation point requires a more difficult decision. In order to get the maximum benefit from the implemented surface system and still postpone the most capital intensive decisions, the choice is among construction of the Van Ness underpass or the Lombard tunnel, the purchase of additional ferries, and the purchase of additional ferries coupled with a decision to proceed with the subaqueous tube. This last choice is a two-step choice because of the long lead time required for implementation of the tube and because it is considered to be mutually exclusive from the other construction choices. Commitment of capital funds for the Van Ness underpass or the Lombard tunnel, as presented in this strategy, precludes a later choice of the tube.

The alternative chosen would begin operating in a 1985 to 1990 time frame. Forecasting conditions beyond 1990 requires many assumptions to be dependable. However, the Van Ness underpass improvement would have a limited service life since buses must still operate on North Point and The Embarcadero, whereas the Lombard tunnel improvement should last indefinitely, well into the 21st century. Either of these two construction options could have the duration of their effectiveness extended by adding more ferries at a later date. Similarly, choosing to start this period with more ferries allows the selection of the Van Ness underpass or the Lombard tunnel at a later date.

Finally, if the subaqueous tube alternative has not been selected, one of the subsurface alternatives may be required in the future, assuming that the transportation demand in the Golden Gate corridor exceeded the capacity of the post-1990 highway and transit network.

The use of such an implementation strategy as part of the long-range transportation program for the Golden Gate Corridor would permit the continuation of the planning process, provide maximum flexibility for future decision-making, and provide continued transit improvements with phased capital investments.

E. CITIZENS ADVISORY PANEL POSITION PAPER

The following position paper by the Citizens Advisory Panel (CAP) is enclosed in the report with the intent of raising issues which are of concern to the CAP and are beyond the scope of the study which was concerned with only bus route selection within San Francisco.

The CAP position paper is based on an earlier Draft Report. Changes have been incorporated into this Final Report which reflect some of the CAP comments in this position paper.

POSITION PAPER ON
KAISER DRAFT REPORT
BY
CITIZENS ADVISORY PANEL - GOLDEN GATE TRANSIT

BASIC PHILOSOPHY

The Citizens Advisory Panel has used the following criteria as a basis for evaluating the Kaiser Report:

A. Any future growth in Marin and Sonoma commuter traffic must be accommodated in public transit.

B. Transit solutions must improve the quality of life in the San Francisco neighborhoods impacted by the Golden Gate commuter traffic, and should not simply maintain the status quo of loss of parking, noise, safety problems and congestion. Otherwise the transit solutions offer no benefits to San Francisco residents who will have to pay for them--financially and environmentally.

C. Any transit solution must include a reduction in auto traffic within the San Francisco portion of the Corridor. Unless means are found to restrict the flow of automobiles into San Francisco we have an insoluble problem which no transit system can solve. Most San Francisco residents are not willing to have Marin commuters drive through their neighborhoods in either buses or automobiles. The solution lies in dis-incentives that will discourage the use of private autos coupled with efforts to minimize the impact of transit on San Francisco's residential areas. Dis-incentives should include some means for "throttling" auto traffic on Doyle Drive, the Golden Gate Bridge, or on Waldo Grade, as well as economic dis-incentives such as higher tolls or variable tolls in peak hours--for cars with more than one occupant.

D. The direct cost of any transit system improvements must be borne in large measure by those who will benefit from its use rather than the San Francisco tax payer who is already paying a high indirect cost in both taxes and degradation of his environment. However, to the extent that transit improvements can be shown to have a direct benefit to San Francisco residents, the cost of such improvements should be shared by San Francisco tax payers.

Viewed from this perspective, the CAP offers the following comments on the Kaiser Report:

General

1. The Kaiser Report provides a generally accurate evaluation of individual route segments. However, the report does not present a comprehensive "strategy" for solving the corridor transportation problems. Before considering detailed solutions there needs to be some agreement on an overall policy objective. The CAP's basic policy objectives are outlined above.

2. Generally, the political and community concerns voiced by the CAP during the study are included in Kaiser analysis.

3. The report does not define in an easily understandable format the costs and benefits to commuters and San Francisco residents that will result from each of the proposed alternatives.

For instance, the report provides no comparison of the present and projected auto and bus loading in the proposed routes. If residential neighborhoods are to accept an additional 50-100 one-way buses per day on their streets, they will expect a reasonable coincident reduction in auto traffic. Such comparisons are not provided in the report. Without such comparisons, it is unlikely that any of the proposed schemes will be acceptable since their comparative benefits are not obvious to the reader of the report.

Subsurface Alternatives

The CAP is opposed to any major subsurface bus system in San Francisco to solve the Golden Gate Corridor transportation problems. Residential and commercial areas of San Francisco would have to pay too high a price in terms of environmental and disruptive impacts for such a system.

Surface Routes

1. Any contra-flow treatment of Lombard Street will create an additional traffic lane for automobiles. Such proposals are acceptable only if coupled with positive steps to control auto flow at its current level on the Bridge, Doyle Drive or the Waldo Grade.

2. The CAP questions the assumptions made by the consultants that the Bay/North Point segment can handle the projected increases in traffic for 1990 without drastic impacts on that neighborhood. The report does not provide sufficient information to permit conclusions regarding these impacts and traffic capacity. If this impact is severe, no viable single surface route remains in the study.

3. The dispersed surface route alternative has more merit than is indicated in the study. The CAP feels that more work is required on this alternative to describe its impacts and potentials--both with and without a single route surface alternative.

To be acceptable, any dispersed system route using Park Presidio/Geary must create a left turn lane on Park Presidio at Geary for the use of both buses and automobiles.

Subaqueous Tube

The CAP is disappointed with the quality of the work done by MTC in relation to the subaqueous tube alternative. MTC's report shows insufficient technical analysis, and its conclusions are unsupported by facts.

Ferry System

The CAP generally endorses an efficient, high capacity ferry system as the obvious solution to its dual objective of increasing transit capacity while decreasing impacts on San Francisco residential neighborhoods. In addition to the presently proposed high speed system, the CAP feels the same benefits might be obtained at a far lower capital and operating cost by providing effective dis-incentives to automobile use and a lower speed, utilitarian, efficient ferry system with good feeder bus service in Marin County *and* San Francisco.

Conclusions

There is no consensus among the CAP as to which of the transit alternatives described in the consultants' report is the appropriate one for San Francisco. Concerns exist by the CAP that none of the alternatives presented address the issues described under "Basic Philosophy" above (simultaneous reduction in the flow of private autos, and improvements to the impacted neighborhoods). In addition, the CAP feels that more work is required to clearly define the impacts and benefits associated with each alternative before a clear consensus can be reached. Perhaps this can be done during the public hearing phase of the project.

The CAP is in general agreement that a ferry system is the most obvious long range alternative presented to reduce commuter impacts on San Francisco neighborhoods within some realistic financial constraints if an efficient, reasonable cost system is developed.

To the CAP, economy alone is not the solution. There will be serious impacts and costs to San Francisco neighborhoods with the economic solution. However, if the number of lanes on Doyle Drive or the Golden Gate Bridge could be reduced, thereby reducing the flow of private cars, San Francisco citizens might be willing to pay this price in order to gain the benefits of less auto traffic.

The consultants' report fails to indicate the benefits to San Francisco neighborhoods to be gained by the various alternatives. It only indicates the penalties these neighborhoods will be required to pay. The CAP believes San Francisco residents *would* be willing to pay for a system that *improves* the current situation.

In the final analysis, the consultants' report fails to indicate the benefits to San Francisco neighborhoods to be gained by the various alternatives. It only indicates the penalties these neighborhoods will be required to pay. The CAP believes San Francisco residents *would* be willing to pay for a system that *improves* the current situation.

More work must be done to provide and demonstrate the benefits to San Francisco residents to show that an improved transit system will really be an *improvement* to the quality of their lives and their environment.